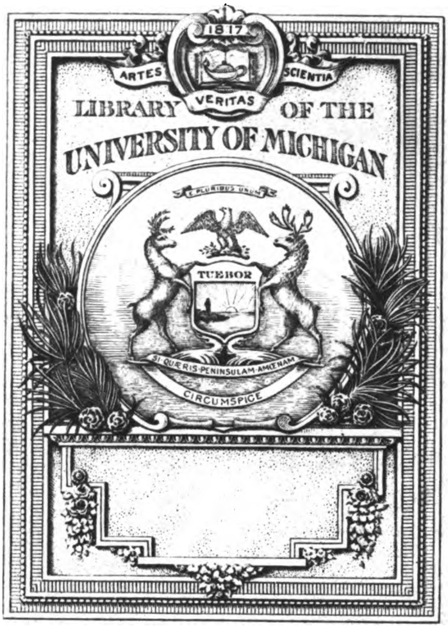
1817
ARTES
VERITAS
SCIENTIA
LIBRARY OF THE
UNIVERSITY OF MICHIGAN
E PLURIBUS UNUM
TUEBOR
SI QUÆRIS PENINSULAM AMŒNAM
CIRCUMSPICE

FIRST ANNUAL REPORT

OF THE

BOARD OF CONTROL

OF THE

NEW YORK ~~STATE~~ agric. EXPERIMENT STATION,

For the Year 1882.

TRANSMITTED TO THE LEGISLATURE MARCH 6, 1883.

ALBANY:
WEED, PARSONS AND COMPANY, PRINTERS
1883.

General

STATE OF NEW YORK.

No. 98.

IN ASSEMBLY,

MARCH 6, 1883.

REPORT

OF THE BOARD OF CONTROL OF THE NEW YORK EXPERIMENT STATION.

To the Honorable, the Legislature of the State of New York :

The New York Agricultural Experiment Station has grown out of the necessities of farmers. Within the past forty years the conditions of success in practical farming have changed greatly; they are more complex, there are new elements, hindrances not known in the earlier husbandry of this State, natural and artificial influences to increase the hazards of all crops, discouragements that have driven many thousands of our citizens to newer fields in the west and seriously lessened our own productive industry. Among these hindrances and discouragements are the ravages of insect pest, many kinds of recent introduction, changed character of the seasons, especially in more frequent droughts during the summer months, new and fatal diseases in flocks and herds, multiplication of injurious weeds, and in many localities serious exhaustion of soil. In the cheapened transportation of all products of farm industry from the more fertile fields of the west our farmers have found competition against which they may contend successfully only by the employment of the highest skill, and even with that accessory, they must be content with diminished rates of profit on the larger capital invested.

All these adverse influences, operating with accelerated force, have had visible effect in depriving the agriculture of this State of that encouragement which is necessary to healthful growth and development, and they have also been the immediate cause of transferring to other States a material portion of the labor that under more favorable conditions would have remained to preserve and increase the importance of our own Commonwealth. In view of the increasing disabilities pressing heavily upon every branch of farm industry, thoughtful farmers long ago began to seek means of relief, mainly in more thorough tillage, better protection for farm animals, improved seeds, ex-

tensive drainage, artificial fertilizers, and generally in the acquirement of knowledge leading to higher skill in all the methods of their labor. Without doubt they have corrected many of their own faults in farm management, but they have not been able to ameliorate the conditions of their industry, except as individual skill and effort have wrought favorable change, the principal difficulties still existing, because individual effort has been wholly inadequate to cope with them.

Every advance has given clearer view of obstacles too great to overcome, except through some form of organization by which there might be greater and general attainment of knowledge in all that constitutes the science of agriculture, and the requisite skill to make such knowledge available in farm practice. The various agricultural societies of the State, although useful in their respective fields, have been quite inadequate to the correction of evils fastened upon an embarrassed industry, assailed by forces mysterious in their origin and destructive in their work, devastating fields, decimating herds, blighting fruits and otherwise neutralizing the faithful labor of the husbandman who has thus to contend in the dark against increasing odds. In the various branches of physical science in which intelligent practical agriculture must find direction there has been material advancement in the last few years, but it has not been general. Here and there a student, stimulated by unselfish enthusiasm, has engaged a careful research planned for the development of truth and his labors, pursued at great cost, perhaps, have been indeterminate, the results problematical, their application doubtful, because in all there has been no authoritative expression supported by extended tests.

These considerations having at last the force of unanswerable argument favoring the establishment of a State Experiment Station attention was given to the want, especially by the principal agricultural societies within the State, including the State Society, the State Grange, the American Institute Farmers' Club, Central New York Farmers' Club, Elmira Farmers' Club and Western New York Horticultural Society, to which was added the influence of Cornell University and the expressed desire of farmers throughout the State for a station where experimentation, supported by the public, might solve the thousand perplexing problems affecting the welfare of agricultural industry. In compliance with this desire the Legislature of 1880 authorized the establishment of the New York Agricultural Experiment Station by an act passed June 26, 1880 (chapter 592), the work to be directed by a Board of Control, comprising ten members who were the executive officers of the agricultural societies already named, and, *ex officio*, the Governor of the State, and two others, to be elected after organization. Within the time prescribed in the act these members met in the executive chamber and effected organization preparatory to the election of two members to complete the board, and at a subsequent meeting selected the two members, elected a president and a secretary, and appointed a committee to report plan of operations. This committee, Robert J. Swan, President, and N. M. Curtis, Secretary of the board, W. A. Armstrong and Richard Church (Messrs. Swan and Church, the two members appointed by the board under provision of section two of the act), entered immediately on the work assigned, and after several meetings in which careful considera-

tion of the work contemplated was had, reported a plan in December, 1880; but the arguments and reasons that by slow processes had brought the committee to conclusions had again to be considered by the full board, thus necessitating delay that full accord might follow reflection. In February, 1881, satisfactory agreement was had, the plan of work embracing the purchase of a suitable farm and its equipment with all the appliances for careful field experiments, together with scientific investigation, and the employment of a capable director with a staff of assistants to take immediate charge of the work.

As the preliminary step, exceedingly important in all its bearings, the selection of a farm became at once a matter of deep concern. Proposals were invited and received from twenty-two counties of the State, but choice at last designated a very desirable farm near Geneva, admirably located, with buildings well suited to the purposes in view, soil and accessories well adapted to the objects sought, and the price so low that it scarcely covered cost of structures ready for the uses of the station. Meantime, a supposed defect in the law establishing the Experiment Station became to the Comptroller an insuperable barrier to further progress, for, as alleged, the appropriation was in violation of the Constitution, and could not, therefore, be available. Although this view was controverted by the Attorney-General in a written opinion, it was deemed advisable to avoid all controversy, if possible, and a new bill was accordingly prepared to meet the objections urged, and in due course became a law, designated as chapter 702, passed August 15, 1881, under which the action already reported, which resulted in the selection of a farm, was had, and the title of the farm passed to the State in February, 1882. For full account of the work performed, implements, machinery, apparatus, animals and equipments, together with cost and manner of service, we beg leave respectfully to submit the accompanying reports of Robert J. Swan, Treasurer, and E. Lewis Sturtevant, Director, all of which have had careful consideration and approval by the Board of Control.

ROBT. J. SWAN,
President of the Board of Control.

N. M. Curtis,
Secretary Board of Control.

1882.

ORGANIZATION OF THE STATION.

Board of Control.

Governor A. B. CORNELL, Albany, N. Y.

ROBERT J. SWAN, President, Geneva, Ontario Co., N. Y.

Gen. N. M. CURTIS, Secretary, Ogdensburg, St. Lawrence Co., N. Y.

PATRICK BARRY, Rochester, Monroe Co., N. Y.

W. A. ARMSTRONG, Elmira, Chemung Co., N. Y.

JAMES McCANN, Elmira, Chemung Co., N. Y.

Prof. S. W. CLARK, Spencerport, Monroe Co., N. Y.

DANIEL BATCHELOR, Utica, Oneida Co., N. Y.

J. S. WOODWARD, Lockport, Niagara Co., N. Y.

A. V. MEKEEL, North Hector, Schuyler Co., N. Y.

Director.

E. LEWIS STURTEVANT, A. M., M. D.

Assistant.

HENRY H. WING, B. Agr.

Horticulturist.

EMMETT S. GOFF.

Chemist.

S. MOULTEN, BABCOCK, A. M., Ph. D.

Stenographer.

ROBERT WATSON.

REPORT OF THE DIRECTOR.

To the Board of Control of the New York Agricultural Experiment Station :

GENTLEMEN — I hereby submit my first annual report for the year 1882.

Arriving at Geneva February 28, I took possession of the Station property March 1, and on March 3 employed a janitor previously hired through the assistance of Mr. Swan. The former owner was still occupying the buildings, and the whole premises, including the barns and out-buildings, were out of repair and in disorder. On March 2 I engaged carpenters, and the carpenters' work done to date comprises the general repairs of the house and buildings, the putting in of library shelves and office fittings, the fitting of the laboratory and the work-room, the making of a passage-way to the second story L room, which had never been connected with the main building, and to which there was no means of access except through the windows, the carrying of a dumb-waiter from the kitchen to the south-east second story room, the fitting of a pantry, the fitting of an experimental cattle barn, the building of a green-house, and the necessary carpenters' work required for the purposes of the mason and plumbers.

On March 27 a mason commenced work by repairing plastering, and at various times has worked at cutting through the doors for the passage-way to the L room in the second story, one door in cellar to walk under piazza, the deepening of the cellar window, the laying over piazza walks and repairing brick edgings, the building of a lysimeter pit, of a tank in the garden, of a silo, of a pit for the gas machine, on walls of the green-house, and various miscellaneous work about foundations of buildings, mending, plastering, etc.

A painter was employed in doing the work made necessary by the changes in the dwelling, and a glazier was required to replace many panes of glass. The painter and glazier were also employed upon the green-house structure, which was completed in October.

About the last of April the plumbing was found to be in such shocking condition that it seemed wiser to re-plumb than to attempt an almost interminable series of repairs ; hence, the first of May the old pipes and connections were restored, and in addition pipes were carried to the cellar and laboratory, to the pantry and wash-room.

In October we had completed the putting in of a Springfield gas machine for furnishing gas for laboratory use, and had in running order

one of Dunning's No. 4 steam boilers connected with a system of pipes and radiators, furnishing heat to the dwelling and steam for use in the laboratory.

The only addition which has been made to the buildings during the year has been the construction of a green-house.

Such was the confusion and so varied the work during the first few months that it has seemed impracticable to keep such a close record of where the labor was expended as was desirable. We have made, however, a close estimate as given below. The weather during March was stormy and boisterous, and this continued to be the case throughout the greater part of April. The farm team arrived on March 21, and has been worked on every suitable day since. The March labor, not including janitor and assistants, was $44\frac{1}{2}$ days; in April, $238\frac{3}{4}$ days; in May, $214\frac{3}{4}$ days, etc.

LABOR DISTRIBUTION IN DAYS.

	March and April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.
Lysimeter	10	12¾	....	....	....	....	....	....	....
Wheat	11	1½	....	16½	35½	7¾	6¼	....	....
Garden	49	69¾	83¾	80¾	80¼	43	37	8½	....
Flower garden	63	32¾	33¾	2¾	....	....	....	....	...
Potato crop	20	3	6¾	1½	7¼	9¼	....	....	....
Cereals	3	....	5¼	1	2	25¼	....	....	....
Silo	4	....	2¾	....	3¼	33¾	....	....	....
Corn experiments	....	39¼	67¾	45½	1	9¾	29½	3½	....
Forage crops	....	2¾	22	8½	½	½	12	....	....
Fodder corn	....	1½	7¼	½	....	....	....	....	....
Haying	....	....	11	107½	....	....	....	....	....
Orchard	....	....	....	....	....	7¾	35½	....	....
Draining	....	....	....	....	80½	....	21	1	....
Setting gas machine	....	....	....	....	12¾	2	....	....	....
Water-works	....	....	....	....	4	3	....	....	....
Green-house	....	....	....	....	....	33	8¼	1	....
Stock	....	....	...	....	....	....	....	....	14½
Miscellaneous to balance	123¼	51½	40½	25½	39¼	70	45	35½	37½
	283¼	214¾	280¾	290	266¼	245	194½	49½	52

On March 1 my assistant, Mr. H. H. Wing, arrived, and very soon became of very material assistance. He is now imbued with the spirit of the work, has become accustomed to the duties of the Station, and is a valuable member of the staff. On March 17 Mr. E. S. Goff arrived to serve as horticulturist, and has proved a thoughtful, earnest, industrious man, whose services derive value through the thoughtfulness and intelligence displayed. On July 1 Mr. S. M. Babcock arrived to serve as chemist to the Station. Formerly assistant to Professor Caldwell, at Ithaca, he comes highly recommended. His services this season have been of a valuable character, and although the laboratory was in a very incomplete state until October, yet work has been carried on despite inconveniences. On July 4 Mr. Robert Watson came as stenographer and confidential clerk. His services have been of a valuable character, and add greatly to the facilities of the Station work.

The difficulties which have been met in organizing and equipping the Station have been trivial, yet numerous and wearing. There has been a necessity for attending to trifling details to an extent detrimental to the thought work and the office work, which are more particularly my duties. Work desirable to be done has been postponed almost to the extent of deserving censure, yet the data for hereafter doing this work has been carefully kept. The expense of fitting and putting into condition has been quite large, yet I feel assured that there has been little waste.

The experimental work has not been neglected in any of its essentials, yet even here work which convenience required has frequently been postponed through the labor being employed in attending to duties connected with organization. What we have accomplished this report will indicate. It seems proper to express the hope and belief that the work of another year, freed from the embarrassments which necessarily accompany the establishment of a new and untried scheme, will yield far greater satisfaction both to yourselves and to your director.

Your director must express his belief in the great significance and the great value to him of the unanimity of opinion, cordiality of feeling and deep interest in his work which has been the constant characteristic of the board of control. All criticism from this source has been cheerfully welcomed and even asked for, and it will be the effort of the director to continue the work according to the word and the intention of the orders to which he shall be subject. Your director is especially anxious to assume for himself no prerogatives, no privileges which the board would have a hesitancy about granting, and his constant feeling is that the public funds and public property are for the entire use of the public and not to be expended for his own convenience. He therefore asks that a constant watchfulness be kept by the board upon his acts so that inadvertencies may be at once discovered and remedied. The board cannot exercise a too close control over the financial matters of the Station, for with the best of intentions there is always a chance of waste occurring here. The director asks the cooperation of the board in preventing extravagance and in forwarding expenditure really needed for the thorough carrying out of the plans and duties of the Station.

The work of the first year has necessarily been largely devoted to organization and preparation. Nominal possession was taken of the premises on March 1, but real work only began in April, and it was some time before we were ready to begin upon experimental work. The buildings and land were in disorder, and we were reminded at times of the Augean stables, which required the labors of a Hercules to cleanse; but we enjoyed this satisfaction, that we found little that could be classed as filth.

The Station land surveys 125 acres, and is mostly of a level character, or in slightly rolling fields. Diagonally through the farm, in a narrow valley, flows Castle brook, dividing the farm into two sections.

The soil is of a clayey character, lighter on the north and east, and passing into heavy clay on the south and west. Upon the north-west side the orchards and gardens, comprising 643 apple, 97 peach, 77 pear and 37 cherry trees. In the poultry yard there are 28 plum trees, and in the garden a few quinces, currants and raspberries.

The soil, originally of fine quality, was found in places to be in a reduced state of fertility and foul with weeds, the land under-drained, but the drains apparently laid shallow and many of the lines apparently choked at some points.

The dwelling-house is substantially built of brick. The main building, 46x42, three stories and a basement, the L 17x34, two stories and a basement. A piazza 7 feet 4 inches wide, supported on iron columns, railed in with iron, and metal-roofed, surrounds the whole edifice. The business rooms in the basement comprise a furnace-room and laboratory 11x26 feet, a work-room 14x29 feet, and a closet for use of the janitor. On the first story, the east room, 17x40, is fitted as a laboratory. The west room, 15x29 feet 8 inches, is furnished as a public office, museum and reception-room; in the rear of the public office, a fine wash-room; in the L, a working office 15x12, and in the extreme south end, the director's office, 15x20 feet. The kitchen, in the basement, is in use by the director's family, and two basement rooms furnish lodgings to one of the officers. The second story serves as a dwelling for the director, and in the third story three rooms are occupied by officers of the Station.

Spring-water, brought from a distance of nearly two miles, furnishes a good supply for the laboratory and one faucet on the first floor, and for two faucets in the basement. This same water supply suffices for two fountains on the lawn, and for the purposes of the barns and stables. A tank in the upper story, collecting the rain-water from the roof, furnishes water supply for domestic purposes. A connection between the spring-water and tank system of pipes enables the cistern to be kept filled independently of the rain fall.

To the south of the dwelling, separated by a road-way are a line of buildings comprising a small octagonal ice-house, seven feet on the side; a brick coal-house, 11x26; a stone building, 28x32, the ground floor of which has been fitted as an experimental cattle farm, while the basement is utilized for the storage of roots and vegetables, the attic for the keeping of labels; a poultry-house, also of stone, 28x31; and a frame stable, 40x60, the lower floor being used for the horses,

the ground floor as a carriage-house and for tool-rooms, and the upper story as a storage for hay, rooms for the janitor, etc. To the south of this range of buildings just mentioned is the implement barn, 25x41; the main barn, 41x55, with an L attachment, 61x32. In this main barn a silo has been built. To the east of the stable a green-house and laboratory have been constructed. The potting-room, 12x18 feet, with a laboratory over head, both opening into the glass-house of slightly irregular shape, measuring eighteen feet on one side and thirty on the other.

The Station buildings occupy the crest of a hill, and from the piazzas and cupola a fine view opens up in every direction. The east view, looking over the village of Geneva upon the lake, is particularly pleasing. The distance from the center of the village of Geneva to the Station is said to be about one and one-half miles by the road.

The Station seems to be particularly fortunate in its location, as the character of the building and the land are admirably fitted for its purposes, and it is by no means inaccessible to the public. Our visitors' register was opened April 1, and to date we have 626 names of visitors recorded.

The theory under which the direction of the Station is acting is the necessity of applying to agricultural research the principles which have accomplished so much in the pursuit of science, namely: The accurate ascertaining of facts, then the grouping of these facts in order to show the laws under which these facts are produced and modified, and finally the test or verification. Agricultural experiment also includes the adaptation of facts and laws obtained to practical affairs. It is only as the laws under which our results are obtained become verifiable that they become worthy of being esteemed scientific. In experimental research, however, we must be very careful to distinguish between the facts which we obtain, and the theories by which we attempt to explain. The first, if rightly apprehended, are absolute knowledge; the latter are subject to change as we progress in knowledge, and require at first frequent verification. To obtain information which applies to one soil and one climate is something, but if this were all that we hoped for it would seem scarcely necessary to be at the expense of the fittings required for the combined use of a scientific and practical establishment. The just expectation is rather, that our work should deal with the laws governing production in husbandry, the determining the value of the facts which are under the farmer's control, and the methods under which control may be most assured, and by so doing give possession to the world of knowledge which shall be independent of any one soil or any one climate. In the pursuit of this course collateral information of interest and value, local and otherwise, must necessarily be obtained, and will serve to enhance the value of the Station to the community. To fulfill this expectation necessitates much expenditure of work, even of toil, and of money, but if results are obtained, even a tithe of what may be expected, we may say that in the establishment of this Station the people of this State have made a judicious and economical investment.

The province of an agricultural experimental station is not so much the discovery of new facts as it is the testing of applications and the

theory of relations. Its ultimate object is to give expression to values which shall assist the farmer in the largest sense in meeting and overcoming the various obstacles which arise in the practice of his pursuit. The business of agriculture is one of relations between factors which may be classed as those subject to control and those which are localized by natural circumstances, but which may in a degree be subjected to the influences of man. In the former class may be itemized seed, cultivation, fertility and the timing of processes. In the second class we may mention climate and soil. Thus the farmer can determine what crop he shall raise, how much cultivation he shall apply, how much fertility he shall add to his soil, when he shall plant and cultivate and fertilize and harvest. In order to act the most wisely, the farmer should know what the value is of the seed he is using, know the circumstances of changed culture and fertility, as well as should know whether through improvement in the seed the relations of culture and fertility may not become changed. In a word, should relations of processes change as change in the individual factors occur? If the seed be improved, does this mean in obtaining the best results a change in the amount of cultivation applied and fertilizer used? It seems reasonable to believe that fertilizing or cultivating beyond the capacity of the seed to produce is a waste, as also to believe that cultivating or fertilizing below the capacity of the seed to produce is also a waste. To determine the value of these factors and their relations is a fit subject for agricultural experimentation, but there are also various other collateral as well as separate objects which may also be profitably subjected to study.

In husbandry we deal with the relations of agriculture, with those of stock raising and management, as well as with the utilizing and manufacturing of products, and thus are dealing with a more complicated series of inter-relations. While agriculture deals with crops, husbandry covers the whole field of farming practice. There is, hence, a wide field of experimentation open here, not only in determining the values of food and stock, but also in seeking for the relations that exist between the stock and the farm crops, the stock and their produce, and between the product and the farm system.

The duties of an agricultural experiment station comprise dissemination as well as investigation. To bring its experiments before the public, not alone through its annual report, but as well in other ways, is a duty that could not be neglected. Hence, at the earliest practical moment, your director commenced the issuance of weekly bulletins, which were printed upon slips, and copies sent weekly to the agricultural press of the State, to all other papers which applied, to the directors of other stations, and to such papers without the State as sent copies of their publications in return. A few copies were also mailed to gentlemen who occupy no public position, but who are identified with agricultural progress. Bulletin No. 1 was dated July 24, and this and its successors bear the following superscription: "These series of frequent reports are intended to inform the public of progress at the station rather than to give complete results." These bulletins have been extensively copied by the local press and by the agricultural press of regions widely separated.

Special effort has also been made to instruct visitors, by showing them carefully the data upon which results were formulated, and careful attention has been invariably paid to all suggestions. This meeting with practical farmers has been of advantage to us as well as to them. We have thereby been enabled to become acquainted with their wants and their views, while abundant hints of how to do, as well as what to do, have been received by us. Certainly there is no means superior to those which come from the association between the officers of the station and the farmers themselves to enable us to keep abreast of the times and to give to us that vigorous enthusiasm which leads to the most direct methods of obtaining results. We desire the farmers to understand that every intelligent visitor we have is a positive benefit, and that we never begrudge the time necessary for courteous entertainment.

In selecting subjects for investigation which are practical, rather than scientific, we deem we have fulfilled an important duty. There is no more reason that science should not be studied in its bearing upon practical and economic affairs than there is that practical and economic affairs should be studied without the aid that science has to offer. Yet we would not be understood as in any way attempting popularity by decrying science. It is only when methods approved by science are applied to agricultural investigation that we may hope for adequate response to systematic study. To study agriculture without the aids that science furnishes would be as profitable to the worker as the building of a railroad without preliminary survey would be to the stockholder. The field for agricultural study is very extensive. There is room in it for pure science; and there is also abundant room for the science that applies to practical affairs. This Station, however, was organized in the interests of the latter rather than of the former, and our duty compels us to leave to others that agreeable and fascinating work of seeking for knowledge for its own sake, so long as the equally good knowledge which relates to practical problems is pressing and is pressed upon us for acceptance. How well we have acted up to our own idea of duty, this report will determine.

In using seeds purchased from seedsmen we were continually subject to the liability of a mixture of varieties in the same seed package, and to defects in the vitality of the seeds used. To avoid these inconveniences in future we shall, as far as possible, use seeds of our own saving, by which means we can, through the proper selection of normal plants as seed producers, and through the preservation of seeds of known age and ripeness, be able to determine whether vitality of seed varies with varieties of a species, and as well the normal character of varieties as regards productive qualities. Thus, when we noted this year that but one Early York cabbage out of nineteen plants came to head, we could only give the figures as those of our trial, but we cannot feel assured whether this failure in heading was an accident of the seed used, or whether peculiar to the variety.

Our whole experience this year justifies the reflection that our seedsmen scarcely exercise the proper care in the sending out of their seeds, and in assuring quality in their varieties. So general does this remark seem that we are not justified in naming defects in the seed obtained from individual seedsmen. We may, however, remark that our ex-

perience with "grocery seeds," that is the packages from boxes distributed to be sold on commission, has been so extremely unsatisfactory that we are fain to believe that it is only the ignorance of the purchaser that retains this abominable system of sale. The purchaser who knows the importance of good seed avoids these commission seeds and sends for his annual supply directly to the seedsman, a course which is rendered easy through the admirable facilities furnished by our post-office department and the various express companies whose lines ramify so extensively throughout our country. It is safe to say that the farmer or gardener who, from carelessness, lack of forethought or a false economy purchases his supply from these commission packages, in the end loses dollars where he saves cents; secures temporary convenience at the expense of future tribulation. It is difficult for the average grower of crops to realize what experience invariably teaches, that cheap seed means cheap yield; that quality in seeds costs the grower and costs the dealer and must be paid for in the end by the purchaser; that high cost seeds, provided there is honesty in the growing and sale, are the only economical seeds to buy. The Station work in future years will probably prove the truth of these statements gathered from our common, as well as this year's experience, and will show the seedsmen and the public the economy and desirability of supplies of "pedigree seed" furnished and purchased at an advanced price over ordinary good or ordinary seeds of sale and use. In the report of the horticulturist will be found further remarks and evidence.

The subject of soil temperatures in relation to germination and vegetation of seeds is an important one which it will take several seasons to investigate sufficiently to justify drawing close practical deductions. As the thermometers essential for this investigation required to be made to order, and as this took time, we were unable this year to take such thermometrical readings during the spring as would satisfy. With ordinary cheap instruments set in two places some distance apart at depths of one, three and six inches, and later at nine inches, we found that there was a quite close agreement of the two sets at the 7 A. M. observation, so that after a time we were content to record the readings of but one set, and to assume that these readings would suffice to give results which might be considered relative in character from day to day, and which might explain the differences noted in the vegetation of seeds planted at various dates. In this hope we were mistaken, as there seems strong indications that the maxima temperatures affect vegetation of seeds to a greater extent than do mean temperatures, and that for the most rapid and reliable germination and vegetation there must be a succession of changes in the temperature from high to low. Through the ascertaining the temperature most favorable for the germination and growth of various kinds of seed, we may reasonably hope in the future to deduce practical directions founded upon soil temperature to govern in the planting of farm and garden seeds, but before we can venture upon directions of this kind it will be necessary for us to carefully note not only the soil temperatures at various depths at one date, but also in some way to ascertain approximately the duration of the various temperatures of the day and night. This seems not only an interesting scientific problem, but as

well an important practical determination for the guidance of farmers and gardeners in the planting of their seed, as it is often of importance with many species to get the seed into the ground as early as climatic conditions will admit, in order to achieve success. Thus, with the market gardener, a few days' difference in the earliness of crop means much more gain in price than would be gained by even a large increase of crop at a later period of the season. Seeds planted too early require much care and seem to offer little gain in earliness over seeds planted at just the right time.

LYSIMETERS OR DRAIN GAUGES.

The lysimeters are instruments for collecting and measuring the drainage from the soil. Box frames a little over twenty-five inches square and three feet deep, internal diameter, were made of oak plank strongly ironed at the corners. These boxes were lined with heavy copper fastened to the boxes at intervals by means of heavy copper tacks, and the projection of the copper at the top and bottom bent over the wood and securely tacked, the area measuring after the copper was in place 25.04 inches square, or one ten-thousandth of an acre. The copper was strongly soldered at the joinings, and the tack heads securely soldered into place after being slightly countersunk. May 29, these frames, three in number, were fitted with a temporary cutting edge of angle iron screwed to the lower surface, the cutting edge being parallel with the inside face of the box, and the bevel toward the outside and placed over the sod. By means of a heavy weight placed on top, aided by heavy mauls with which blows were struck upon each of two opposite corners consecutively, a ditch being dug along the outside as the box entered the soil, these frames were forced their whole depth into the soil. A heavy flat section of boiler iron, the edge sharpened, was then forced underneath cutting the frame and contents free, the box and contents inverted, and a bottom of copper, dishing slightly to a common center, where a pipe was inserted and securely soldered, and to which a perforated guard was attached, was strongly fastened into position by bending the copper sides over the edge of this bottom piece and securely soldering.

These three boxes were then carried from the point of filling to the lysimeter lawn, where they were placed carefully in position, their surfaces level with the surrounding ground and the pipe which passed from their bottom carried into a subterranean alcove built below them, and upon the arch of which the boxes rested, with the intervention of about six inches of soil. These alcoves branched from a pit carefully arched and to which admittance is obtained by steps. A bottle kept under each lysimeter and to which the pipe leads enables us to collect all the water which drains through, and a graduated measure enables us to measure this water in thousandths of an inch, thus making a ready comparison with the rainfall, a record of which is kept by one of Green's eight-inch rain gauges located alongside.

Lysimeter No. 1 retains the sod upon its surface; No. 2 has its surface kept bare and undisturbed; No. 3 has its surface kept pulverized during the open season to the depth of an inch or two by frequent stirring with a trowel.

About the top of the frames an edging of hard brass, strictly defining the area, and one inch high is fastened. Hence all the rainfall over this area is compelled to enter the soil, and by measuring the amount which percolates we can account for the balance through evaporation. In having three lysimeters we can calculate the amount of water evaporated from growing sod, from a bare surface, and from a stirred surface respectively. An analysis of the percolated water enables us to estimate the amount and character of the loss of plant food through drainage.

A series of soil thermometers, made by Green, and to be inserted into the ground alongside, at depths of one, three, six, nine, twelve and twenty-four inches, has been procured. We obtained these too late this season for use, but another year we hope to obtain the soil temperature at different depths during the season of vegetation. A maximum, minimum and standard thermometer, also made by Green, finds place upon the lawn in a slatted box constructed for the purpose, and gives us the air temperatures, with the extremes, for the day.

The soil contained within the lysimeters can be described as a dark clay loam, moderately friable for the first eight inches; below this and sharply defined from it is a bed of heavy clay, dark red in color, granular and not very tenacious, about a foot thick; below this a bed of clay about a foot thick, of similar color to the last, but quite compact and tenacious; below this four inches, of a peculiar, soapy soil; below this last, but not included in the lysimeter boxes, was a strong clay hard-pan. Lysimeter No. 3 contains just a little of this hard-pan in one corner, but the others, none of it at all. This seems the general description, but streaks of clay of slightly different appearance and working were irregularly disposed here and there through the soil. Angle worms had their holes throughout the whole mass, down even to the hard-pan.

It was not intended to keep records of drainage until next year, in order to allow settling, if any (for none has yet been observed), and in order that the accidental impurities which might come from the acid used in soldering should become washed out. We have, however, taken the following figures:

Percolation from Lysimeters in Inches.

Lysimeter.	Aug.	Sept.	Oct.	Nov.	Dec.
No. 1	0.00	0.00	0.00	0.00	.001
No. 2	0.135	0.001	trace	0.009	.578
No. 3	0.575	0.284	0.001	0.011	.559
Rainfall	2.371	1.251	0.621	1.220	0.551

We here see a marked influence in favor of the effect of stirring the soil upon conserving the moisture to land. No. 3, kept stirred, holding more water than did the others, required less of the rainfall for saturation and subsequent percolation. The growing sod evaporated more water than did the bare soil, and the bare soil more than the stirred soil.

In connection with the lysimeters we may give the results of an

experiment upon the evaporation of water from the freshly cultivated and ordinary surface soil of our cornfield. This experiment, reported in our bulletin No. V, is here reproduced:

The question of drouth is one which periodically engages attention, and any means by which its injurious effect may be mitigated should certainly be known to the farmer. That cultivation by forming a loose soil upon the surface, which acts as a mulch, conserves the water to the soil, is a fact which is well established, and should be more commonly appreciated. For the purpose of offering numerical values which shall express the influence of cultivation, we have tried the following experiment: Oak boxes of one cubic foot capacity were made of half-inch stuff and thoroughly soaked with oil. The bottoms being removed, the frame was forced down into the earth in the cornfield, and the bottoms afterward put in position. We thus had a foot cube of soil in its natural position. The surface of the earth in one box was left undisturbed, while the surfaces of two boxes were kept cultivated. By weighing these boxes, the gain or loss in weight is assumed to measure the evaporation which has taken place from each. From July 26 to August 1, six days, the cultivated soil evaporated at the rate of 906 gallons per acre less than the undisturbed soil, or less 151 gallons daily per acre. From August 1 to August 10, nine days, the cultivated soil evaporated 2,367 gallons per acre less than did the undisturbed soil, or less 263 gallons daily per acre. During the whole period from July 26 to August 10, fifteen days, the saving of water effected through cultivation figured up 212 gallons daily per acre, or, expressing these facts in another form, the undisturbed soil lost per acre from July 26 to August 10, 4,243 gallons, the cultivated soil 1,060 gallons.

In calculating our results to the acre by multiplying the evaporation which has taken place from a square foot of surface by 43,560, the unavoidable errors are correspondingly multiplied, and while duplicate series can never be expected to give precisely the same numerical results, yet the one fact becomes unquestionable, that through cultivation we are enabled to conserve to the soil a large amount of water during a drouth. Indeed, observation through extended periods of drouth also plainly shows the superiority of fields that have been well cultivated, over those where cultivation has been neglected.

THE LABORATORY.

The former parlor of the dwelling has been fitted up as a laboratory, and the fretted ceiling and handsome white marble mantels add much to the attractions of the apartment. The wall spaces are all occupied with closets, cupboards, shelves and tables. The working tables are supplied with numerous gas and water jets, with sinks, etc., in the positions required for convenience. In the north-east corner large drying ovens of copper have been put in position and are kept hot by the use of steam from the boiler in the room below; next to this is a hood, connected with the chimney by a long narrow opening, and fitted with steam jets for use in evaporating, and with water and gas. Above these arrangements is fitted a brass and block tin condenser, which taking steam from the drying oven jacket condenses it into dis-

tilled water, which is collected in two carboys suitably placed for its reception. Upon the east wall is fitted a table, supported by means of brackets, and thus furnishing a place for balances which is unaffected by tremor from the use of the floors, whether for walking, for pounding or for other purposes.

The apparatus and fittings supplied include every convenience necessary for organic analysis, including a fine balance made by Verbeck & Peckholdt, of Dresden, Germany, and a Soleil-Ventzke saccharimeter, as modified by Scheibler, No. 1,625 of the manufacturers, Messrs. Franz Schmidt & Haensch of Berlin. One combustion furnace of twenty-five burners, one lactobutyrometer of Marchand, and one Soxhlet's apparatus for estimating the fat of milk were also imported from Germany, as well as a large part of our glassware, this course being advisable not only on account of the superior quality of the goods thus obtained, but from motives of economy, as public institutions are not subjected to the tariff duties on importations of this character.

Dr. S. M. Babcock, our chemist, arrived at the station July 1, and for the first few months was busily occupied in attending to the fittings of the laboratory, the compounding of the standard solutions, the testing of the accuracy of apparatus, etc. He has also found time to attend to much analytical work, the larger part of which has been of the nature of a continuous series, the results of which cannot be given as completed until another year.

Among the completed and partial analysis have been the following :

PIG-WEED. Chenopodium album.

Collected July 26, 1882. The plants, thirty-five in number, pulled in the garden from rather hard soil. The weight of green plants, 7.9686 lbs. avoir. ; of roots, .74995 lbs. avoir., or 9.41 per cent of the tops.

The roots contained 73.44 per cent of water. The dry substance contained 8.35 per cent of ash, and 1.42 per cent of nitrogen. The ash contained 2.43 per cent of phosphoric acid, 39.87 per cent of potassium oxide, and 2.31 per cent of sodium oxide.

The analysis of the pig-weed plant in bloom when gathered, gave to Storer the following figures :

	Green plant.	Air dried plant.
Water	80.80	9.81
Ash	3.02	14.21
Albumenoids	3.94	18.59
Carbohydrates	9.69	45.44
Cellulose	2.55	11.95
	100.00	100.00

Luyken found in the dry plant 10.36 per cent of ash, containing 8 per cent of phosphoric acid and 50 per cent of potash.

According to these analyses a ton of the green plant and root would contain 12 lbs. of nitrogen and 58¾ lbs. of ash, containing 4.47 lbs. phosphoric acid, and 28.95 lbs. of potash. Estimating the nitrogen, etc., at lowest market rates we have for an indicated value per ton of green plant for green manuring, 12 lbs. nitrogen at 24 cents, $2.88; 4.47 lbs. phosphoric acid at 6 cents, 26 cents; 28.95 lbs. of potash at 5 cents, $1.44. Total, $4.58 per ton.

In green manuring, however, the nitrogen is the only portion of the fertilizer which is saved from waste; the other ingredients do not wash from the soil.

RED ROOT. Amaranthus Retroflexus.

Some roots collected August 4th yielded to analysis—

	Fresh root.	Calculated to dry substances
Water	80.35	....
Ash	1.94	9.88
Nitrogen	.33	1.66

COW PEA.

The whole plant of the Green-eyed white cow pea was collected August 14th, before the blossoms had appeared, the foliage abundant and succulent. A second sample of the same variety was collected October 7th, when the very few pods it had formed were edible ripe, the foliage very abundant and still succulent. The analyses are as below:

	Whole Plant, August 14.	Whole Plant, October 7.
Water	86.03	82.10
Ash	1.89	1.77
Protein=N. × 6.25	3.25	3.00
Crude fibre	2.87	4.09
Nitrogen—free extract	5.34	8.46
Fat (ether extract)	.62	.58

Calculated of dry substance.

	August 14.	October 7.
Ash	13.60	9.90
Protein=N. × 6.25	23.37	16.68
Crude fibre	20.58	22.86
Nitrogen—free extract	38.00	47.34
Fat (ether extract)	4.45	3.22

STRING BEAN.

On August 9th the pods of the Early China variety of string bean were gathered while in prime edible condition. Their analysis was as below:

	Pods as gathered.	Calculated on dry substance.
Water	83.46	....
Ash	.83	5.01
Protein=N. × 6.25	2.75	16.50
Crude fibre	2.58	15.60
Nitrogen—free extract	10.04	60.84
Fat (ether extract)	.34	2.05

MAIZE.

For the purpose of investigating the changes in the ash constituents of the corn-plant during growth, a number of ash determinations were made. August 18, a number of stalks of Waushakum corn were selected and labeled as uniform in appearance, each having apparently two well-developed ears in process of formation. From these labeled stalks, commencing with August 18th, when the kernels were mostly pollenated, each week a series of five were selected and taken to the laboratory. The figures obtained are herewith given:

August 18th.

No. of stalk.	Height.	Green Wt. Grammes.	Per ct. Water.	Per ct. Green.	Ash in Dry.
1	6 ft. 3 in.	777	87.32	.618	4.87
2	7 ft. 10 in.	953	86.11	.699	5.03
3	7 ft. 0 in.	911	85.12	.670	4.50
4	7 ft. 1 in.	896	85.91	.704	5.00
5	6 ft. 7 in.	1014	85.99	.618	4.41
Mean	6.95 ft.	2.00 lbs.	86.09	.662	4.75

August 25th.

1	6 ft. 6 in.	1265	85.99	.702	5.01
2	6 ft. 9 in.	847	84.18	.748	4.73
3	6 ft. 11 in.	864	82.60	.693	3.98
4	7 ft. 7 in.	1032	84.20	.667	4.22
5	7 ft. 0 in.	912	84.94	.660	4.38
Mean	6.95 ft.	2.17 lbs.	84.38	.684	4.48

September 1st.

1	6 ft. 11 in.	986	81.98	.777	4.31
2	5 ft. 9 in.	684	78.16	.954	4.37
3	6 ft. 7 in.	1325	82.92	.859	5.03
4	7 ft. 6 in.	1028	84.53	.574	3.76
5	6 ft. 1 in.	1060	81.48	.787	4.25
Mean	6.77 ft.	2.24 lbs.	81.81	.784	4.29

September 8th.

1	7 ft. 4 in.	988	77.33	.859	3.74
2	7 ft. 0 in.	1185	76.41	.870	3.69
3	7 ft. 0 in.	1004	77.14	.898	3.93
4	7 ft. 1 in.	1182	78.68	.874	4.10
5	7 ft. 10 in.	1016	77.16	.884	3.87
Mean	7.25 ft.	2.37 lbs.	77.34	.877	3.87

September 15th.

No. of stalk.	Height.	Green Wt. Grammes.	Per ct. Water.	Per ct. Green.	Ash in Dry.
1	7 ft. 0 in.	948	74.14	.881	3.41
2	7 ft. 0 in.	742.5	74.28	.784	3.05
3	6 ft. 3 in.	811	75.21	1.185	4.78
4	7 ft. 5 in.	977	73.69	.905	3.44
5	8 ft. 0 in.	1282	77.73	.719	3.23
Mean	7.13 ft.	2.10 lbs.	75.01	.879	3.55

September 23d.

No. of stalk.	Height.	Green Wt. Grammes.	Per ct. Water.	Per ct. Green.	Ash in Dry.
1	7 ft. 11 in.	960	68.91	.948	3.05
2	6 ft. 5 in.	1134	68.34	.934	2.95
3	7 ft. 4 in.	1276	69.04	.858	2.77
4	6 ft. 4 in.	845	67.93	1.023	3.19
5	7 ft. 7 in.	1203	74.14	.768	2.97
Mean	7.12 ft.	2.39 lbs.	69.67	.895	2.97

We tabulate now the extremes for each of the six periods, as between the five determinations for each.

	Per cent water.	Per cent ash.
August 18	85·12 to 87·32	·618 to ·704
August 25	82·60 to 85·99	·660 to ·784
September 1	78·16 to 84·53	·574 to ·954
September 8	76·41 to 78·68	·859 to ·898
September 15	73·69 to 75·21	.719 to 1·185
September 23	68.34 to 74·14	·768 to 1·023

We thus see how unreliable a single analysis of a single stalk is for the purpose of generalization.

We now present a summary to the totals for each date.

	Weight of 5 plants. Green. Grammes.	Dry.	Weight of ash from 5 plants. Grammes.
August 18	4551	634·6	30·126
August 25	4920	751·6	33·660
September 1	5083	908·3	39·874
September 8	5375	1217·	47·112
September 15	4760	1179·5	41·850
September 23	5418	1633·5	48·488

	Per cent of Ash On dry substances.	On green stalk.
August 18	4·75	0·662
August 25	4·48	0·684
September 1	4·39	0·784
September 8	3·87	0·877
September 15	3·55	0·879
September 23	2·97	0·895

On September 13th the Waushakum corn in another part of the field was pronounced ripe and fit to cut. It was at this time much riper than it has been used to being cut for crop, at least a week. While our analyses do not strictly define at what time the corn plant ceases to feed from the soil, yet, if we note the variations between individual plants collected the same day, we may suspect that the plant absorbed but little ash after September 8, possibly September 1, and that the differences noted may be ascribed to individual variations, and the difficulties of sampling. Thus:

Largest single plant of each gathering.

	Wt. green. Grammes.	Wt. dry. Grammes.	Per cent ash. Dry.	Per cent ash. Green.	Total ash in dry. Grammes.
August 18........	1014	142	4.41	.618	6.26
August 25........	1265	177.3	5.01	.702	8.88
September 1......	1325	226.3	5.03	.859	11.38
September 8......	1185	279.5	3.69	.870	10.30
September 15......	1282	285.5	3.23	.719	9.22
September 23......	1276	395	2.77	.858	10.94

Smallest plant of each gathering.

August 18........	777	98.5	4.37	.618	4.30
August 25........	847	134	4.73	.788	6.33
September 1......	684	149	4.37	.954	6.51
September 8......	988	224	3.74	.859	8.37
September 15......	811	201	4.78	1.185	9.60
September 23......	845	271	3.19	1.023	8.64

This latter method of comparing the largest and the smallest stalks, the extremes, in fact, seems the better way of overcoming the difficulties that meet us, and hence by uniting the two figures of the table we have a table which indicates that the corn ceases to feed to any great extent certainly after glazing has well commenced. Thus, the total ash in grammes is:

	Aug. 18.	Aug. 25.	Sept. 1.	Sept. 8.	Sept. 15.	Sept. 23.
Largest stalk........	6·26	8·88	11·38	10·30	9·22	10·94
Smallest stalk........	4·30	6·33	6·51	8·37	9·60	8·64
Mean.........	5·28	7·60	8·94	9·33	9·41	9·79

Sugar in Corn Stalks.

September 15, one hill, six kernels planted, eight stalks harvested of Waushakum corn, was brought to the laboratory for the determination of the sugar in the juice.

Weight of the stalks and tassels..................	4 lbs. 13 ozs.
Weight of ear corn............................	3 lbs. 15 9-16 ozs.
Weight of foliage, shucks, etc....................	7 lbs. 7 3-8 ozs.
Loss during weighings, etc........................	..... 2 9-16 ozs.
Green weight of the eight stalks...........	16 lbs. 6 1-2 ozs.

The stalks were crushed in a mortar and the juice expressed by means of a jelly press.

Weight of juice from stalks.....................	2 lbs. 11 5 16 ozs.
Per cent of juice	57·06
Specific gravity of juice.........................	1040

Glucose in juice..	2·77
Cane sugar.................................	5·96
Total saccharine..	8·73

On September 18th and September 30th other determinations were made from stalks of the same variety. The results of these trials are as below:

	Sept. 15.	Sept. 18.	Sept. 30.
Per ct. juice obtained from stalks...	57·06	50·17	42·67
Specific gravity of juice...........	10·40	10·48	10·36
Glucose in juice, per ct......	2·77	3·23	1·64
Cane sugar in juice, per ct.........	5·96	6·72	4·54

CORN — UPPER AND LOWER EARS.

Before harvest two stalks of Waushakum corn, each bearing two perfect ears, were carried to the laboratory. The examination developed the following results:

	Stalk No. 1.		Stalk No. 2.	
	Upper.	Lower.	Upper.	Lower.
	Grammes.		Grammes.	
Weight of the ear.....	3132·6	2500	2283·9	1759·2
Weight of the corn....	2634·2	2091	1959·8	1540·1
Weight of the cob.....	498·4	409	324·1	219·1
Per ct. of cob to ear as harvested...........	15·91	16·36	14·19	12·45
Water in corn, per cent.	10·66	9·37	8·66	8·82
Water in cob, per cent..	10·21	10·19	12·38	10·56

Analysis of the dried grain.

	Stalk No. 1.		Stalk No. 2.	
	Upper.	Lower.	Upper.	Lower.
Ash..................	1·35	1·26	1·39	1·39
Protein=N. × 6·25...	12·06	10·75	11·87	10·87
Crude fibre............	1·30	1·23	·74	1·22
Fat (ether extract)....	5·80	5·75	3·45	3·21
Nitrogen—free extract, by diff.............	79·49	81·01	82·55	83·31

AMBER CANE.

For the purpose of determining whether the use of sulphate of potash as a fertilizer was favorable to the production of sugar in the sorghum cane, six plats of one-twentieth acre each were carefully planted with the Early Amber Cane. One plat receiving no applica-

tion of fertilizer; the next plat 200 pounds; the next, 400 pounds; the next, 600 pounds; the next, 800 pounds; and the last, 1,000 pounds of sulphate of potash per acre. The influence of the potash in hastening maturity of growth was quite marked.

The figures of the analyses at the various dates read as below:

October 4.

	Sp. grav. of juice.	Glucose.	Cane sugar.	Total sugar.	Ratio glucose to cane sugar.
No fertilizer........................	1064	3.23	8.73	11.96	1 : 2.7
200 lbs. sulphate potash per acre..	1064	3.93	9.29	13.22	1 : 2.4
400 " " " " " ..	1064	3.41	9.36	12.77	1 : 2.7
600 " " " " " ..	1064	3.72	9.68	13.40	1 : 2.6
800 " " " " " ..	1064	3.72	9.66	13.38	1 : 2.6
1000 " " " " " ..	1064	3.81	9.80	13.61	1 : 2.6

October 11.

	Sp. grav. of juice.	Glucose.	Cane sugar.	Total sugar.	Ratio glucose to cane sugar.
No fertilizer........................	1076	3.20	12.53	15.73	1 : 3.9
200 lbs. sulphate potash per acre..	1072	3.84	11.56	15.40	1 : 3
400 " " " " " ..	1068	3.67	10.70	14.37	1 : 2.9
600 " " " " " ..	1068	3.98	10.63	14.61	1 : 2.7
800 " " " " " ..	1068	3.74	11.77	15.51	1 : 3.1
1000 " " " " " ..	1068	3.26	11.16	14.42	1 : 3.4

October 20.

	Sp. grav. of juice.	Glucose.	Cane sugar.	Total sugar.	Ratio glucose to cane sugar.
No fertilizer........................	1070	2.93	13.15	16.08	1 : 4.4
1000 lbs. sulphate potash per acre..	1068	3.27	12.63	15.90	1 : 3.8

The ash of the cane grown without fertilizer was 2·10 per cent; the ash from the cane grown with 1,000 pounds sulphate of potash application per acre was 2·29 per cent.

The variation in the sugar of the juice from the canes of October 4 is undoubtedly due to the potashed plats being occupied with riper plants; by October 11 the influence of the stage of ripening had become diminished and the potashed plats fell off in sugar yield, which on October 20 becomes well marked again. So far as one year's trial can determine, we may assume with some probability that the effect of the potash was to diminish the sugar yield of the plats where applied, and that the proportion of potash used was of little consequence, the smaller quantity being sufficient, the larger not too much. More important yet, the ratio between glucose and cane sugar seems changed by the use of the potash, thus:

Ratio of glucose to cane sugar.

	No potash used.	Average of potashed plats.
October 4...........	1:2.7	1:2.6
October 11...........	1:3.9	1:3.0
October 20...........	1:4.4	1:3.8

As the crystallization of the sugar from the syrup is hindered by the presence of glucose, we thus see that the use of the potash seems a distinct injury.

The influence of the date of cutting the stalks upon the amount of sugar is well marked. Thus for the average of the plats:

	Glucose.	Cane sugar.	Total sugar.
October 4........ ...	3·63	9·42	13·05
October 11...........	3·61	11·39	15·00
October 20............	3·10	12·89	15·99

That is, as the plant reaches ripeness of seed the sugar increases, the glucose diminishes. This fact, so well brought out here, is a very important one to the sugar-maker.

TOMATO.

August 28 three samples of the Early Acme tomato were taken for analysis. The results as below:

	Fresh tomato.	Calculated on dry substance.
Water...........................	91·26	....
Ash.............................	·73	8·32
Protein=N. x 6.25................	1·00	11·25
Sugar (glucose)...................	3·46	39·54
Free acid (calculated as malic)......	·57	6·52
Crude fibre.......................	·70	8·03
Fat........................... ...	·47	5·35
Other carb-hydrates by diff........	1·81	20·99

SOJA BEAN—*Soja Hispida*.

Two analyses were made of the whole plant of the soja bean, and a partial analysis of the seeds. The figures are as below:

Soja bean plant in fresh state.

	Sept. 19.	Oct. 7.
Water................................	69·35	69·85
Ash..................................	2·36	2·22
Protein=N. x 6.25.	3·94	3·88
Crude fibre............................	8·91	8·26
Fat (ether extract).....................	1·05	1·55
Nitrogen—free extract..................	14·39	14·24

In the determination of September 19, the total nitrogen was 0·63 per cent, and the albumenoid nitrogen 0·52 per cent.

Calculated Dry.

	Sept. 19.	Oct. 7.
Ash..	7·71	7·35
Protein=N. x 6·25............	12·75	12·74
Crude fibre....................	29·06	27·41
Fat (ether extract).............	3·43	5·14
Nitrogen—free extract.........	47·05	47·36

The seed, dried at 212° F., was found to contain 5·20 per cent of ash, 40·37 per cent of albumenoid substance, and 15·96 per cent of fat (ether extract).

MILK.

Four Jersey cows arrived at the Station November 30, after a two days' trip. Three of these were giving milk, and these were milked in

the morning, and, so far as is known, were not again milked until the evening, at the Station, where they were milked clean, and the mixed milk was at once carefully sampled for purposes of analysis. We had hence the milk from fatigued and harassed cows, and analyses were made in duplicate for the total solids, in triplicate for the fat, and in duplicate for the nitrogen, by combustion. We feel assured that this analysis represents accurate sampling, although the results are phenominal in their character. It would scarcely answer to generalize from one case, yet we would call attention to the general belief that harassing of cows diminishes the fat of the milk. The yield of the evening's milkings of the three cows was as below:

	Pounds.	Ounces.
November 30, evening milking	6	12
December 1, evening milking	13	7
December 2, evening milking	15	8
December 3, evening milking	14	4
December 4, evening milking	13	8
December 5, evening milking	14	2
December 10, evening milking	14	6

Mixed evening Milk from three fatigued Jersey Cows.

Specific gravity by weight, 1022·6.
Per cent cream after 15 hours, 30·3.

Fat	10·50
Casein	3·09
Albumen	·70
Sugar	3·23
Ash	·59
Loss, etc	·62
Total solids	18·73
Water	81·27
	100·00

Per cent nitrogen, by combustion, 0·60.

Colostrum.

Meg, a Jersey cow, calved December 4. The colostrum milk was orange yellow, of acid reaction. Specific gravity by weight, 1063. It coagulated into a solid mass by boiling.

Fat	5·22
Casein	7·87
Albumen	7·81
Milk sugar	2·94
Ash	1·23
Loss, etc	·21
Total solids	25·28
Water	74·72
	100·00

Per cent nitrogen, by combustion, 2·35.

FERTILIZERS.

Six analyses of fertilizers were made for private parties, but as we had no control over the sampling, it is not proper to publish the results. The Station must act impartially and justly as between fertilizer manufacturers and the farmers. Sampling is a difficult operation at the best, and unless a sample is properly drawn, it cannot represent the average composition of the mass in bulk.

RULES AND REGULATIONS.

In order to promote discipline and efficiency the following rules for the government of employees were issued in the early spring and have been strictly enforced :

Rules of the Establishment.

The working hours shall be from 6:30 A. M. to 12 M. and from 1 P. M. to 6 P. M., except as otherwise noted.

Every employee must consider himself as his own foreman, must expect to be instructed and directed, but not watched. A man that requires to be watched is not wanted on the place.

Every employee, from the director down, shall give his whole time and duty to the Station during working hours.

All necessary work shall be done irrespective of hours of labor.

All causes of complaint to be at once referred to the director.

Every employee shall exercise due courtesy toward visitors.

Duties of the Assistant.

See that the laborers each morning are assigned to their proper work, and that they are on time and diligent during work hours.

To go to the village after mails and to attend to errands there, unless otherwise directed.

To make the rounds of every experimental plat, and to make proper notes on each and every fact observed in relation to the growing crop, to the condition of the land and the weather.

To exercise supervision over the condition of the buildings, and to accept the responsibility of maintaining precise neatness everywhere, and to especially be responsible that the rules of the tool room are observed.

To care for the surveying and draughting instruments.

To do such special work as may be assigned to him by the director.

To take careful notes of all observations relating to the soil, plant and climate, especially those relating to the condition of the soil, the temperature and the rain-fall in their daily or weekly variations.

To submit his notes and a written report of the day's work to the director each night.

Duties of the Chemist.

To conduct such analytical investigations as may be laid out for him by the director.

To maintain the laboratory in neatness, and to exercise due vigilance to economize and protect the laboratory supplies and fittings.

To keep in books provided for the purpose accurate data of all analyses performed.

To employ himself during working hours in furthering the interests of the Station through chemical work, and to be subject to call to perform whatever work of whatsoever character the director may require of him.

To exercise careful courtesy toward visitors.

Duties of the Horticulturist.

Keep the garden tool-room in tidiness and the tools clean and in place.

Have charge of the lawns.

Have charge of the fruit trees.

Have charge of the garden and green-house in their multitudinous relations.

Report every night to the director the work done, its amount and character.

The horticulturist will also be expected to take full notes of every operation in the garden, observations concerning growth, insect appearances and damage, effect of the weather, temperature of the soil at time of planting, appearance of bloom, edible maturity and of seed maturity, and in general of every matter of near or remote interest.

The horticulturist will also take charge of such special work as may be assigned to him by the director.

The horticulturist will do all the important and scientific work with his own hands, or have it done under his immediate supervision.

The horticulturist will report to the director nightly, leaving his note books and taking them again in the morning.

Duties of Janitor.

Attend to the fires.

Sweep and tidy up the rooms and halls, commencing at the private office.

Sweep upper and lower piazzas and shake out mats.

Care for lamps and lanterns.

Keep work-room clean and tidy and tools oiled.

Supervise the tool-room and report all disorder at once to the director.

Pick up and maintain in neatness the lawns, sidewalk and roads.

Care for driving horse, and keep stables and adjoining buildings in tidiness.

Announce visitors, and exercise proper courtesy toward every caller.

To do whatsoever other work may be assigned to him by the director.

Rules for Laborers.

All laborers will be engaged by the director, under recommendation, in special cases, of the gentlemen in charge of departments.

Every laborer will be expected to be dilligent, and to do faithful, accurate work, precisely as directed by those in charge.

Courtesy will be exacted from the laborer, as well as from those in charge toward the laborer.

No smoking allowed during working hours, nor at any time, about the buildings.

Rules for the Tool-room.

Each tool must have its definite place.

Each tool must be thoroughly cleaned before being put back into place.

Each tool must be in its place at the close of work.

All injury to tools must be at once reported to the director.

The janitor will have supervision of the tool-room, and will report every case of neglect or carelessness at once to the director.

The assistant will be responsible for these rules being carried into effect.

Rules for the Work-room.

No person other than the officers to use the room without permission.

No tool to be removed from the room without permission being first obtained from the director or his assistants.

Every tool, after use, to be returned to its proper place.

The room will be cleaned up each night by the janitor, but those using the room will remove all unusual rubbish.

The Station has been the recipient of a number of presents from those who have taken an interest in its welfare and its doings.

Among the implements and tools received were:

April 15. One Wiard D. Plow, from Thomas Baxter, Oaks Corners, N. Y.

May 2. One box of Smith's Seed Corn Preservers, from Mahlon F. Smith, Monticello, Ind. These are wire spirals for inserting in the butt end of corn ears for hanging and stringing the same.

May 18. One North-western Corn Planter, from Irving P. King, Orleans, Ontario county, N. Y.

May 20. One No. 14 and one No. 12 Plow, from the Remington Agricultural Co., Ilion, N. Y.

August 8. Four wooden forks for pitching barley and other straw, from Alba Kendal, Atley, N. Y.

November 11. One Robbins Improved Cattle Tie, from H. M. Robbins, Newington, Conn.

We have received plants as follows:

April 26. Nineteen plants of Amelanchier Canadensis, variety Oblongifolio, from Benjamin G. Smith, Cambridge, Mass.

April 26. Two Dana grape-vines, two Francis B. Hayes grape-vines and fifty cross-bred Asparagus roots, from John B. Moore, Concord, Mass.

May 17. Fifty Hervey Davis strawberry plants, from John B. Moore, Concord, Mass.

May 24. One Vergennes grape-vine, from J. S. Woodward, Lockport, N. Y.

June 5. A lot of Cauliflower plants from John Fletcher, Geneva, N. Y.

June 20. Fifty Egg Plants, from Robert J. Swan, Geneva, N. Y.

September 16. Four dozen Crocus Bulbs, assorted; forty-three Hyacinth Bulbs, assorted, many named varieties; six Narcissus Bulbs, assorted; and fifty-six Tulip Bulbs, from Hiram Sibley & Co., seedsmen, Rochester, N. Y:

November 4. Fifty-seven economic and ornamental plants for the green-house, from Wm. Saunders, Superintendent of Garden, Department of Agriculture, Washington.

November 27. One dozen slips each of Whitesmith, Wellington's Glory, Bang-up and Glendon Green gooseberries, from B. G. Smith, Esq., Cambridge, Mass.

We have received seeds as follows:

March 8. Fifteen varieties of Sorghum seed, from Peter Collier, Chemist of the Department of Agriculture, Washington, D. C.

March 15. Six boxes of Sorghum, from Peter Collier, Chemist of the Department of Agriculture, Washington, D. C., said to have been grown in China for centuries wholly for forage and seed.

May 31. Two samples of Sorghum seed from India, from Peter Collier, Chemist of the Department of Agriculture, Washington, D. C.

March 18. One bag Black Bearded Centennial Wheat, from E. S. Carman, editor *Rural New Yorker*, 34 Park row, New York city, N. Y.

March 31. Four packages Onion seed, from S. M. & D. Wells, Wethersfield, Conn.

April 8. Six bags of flower seeds from Daniel Batchelor, seedsman, Utica, N. Y.

April 17. Thirty-two papers of assorted flower seeds from J. M. Thorburn & Co., seedsmen, New York city, N. Y.

July 1. One package Bermuda grass seed from J. M. Thorburn & Co., New York city, N. Y.

April 4. Samples of ear corn from D. M. Ferry & Co., seedsmen, Detroit, Mich.

April 18. Six varieties of potatoes for seed; Doolittle's Ontario, Extra Early Peachblow, White Star, White Whipple, Extra Early Gem, and Mammoth Pearl, one of the latter weighing thirty-five and one-fourth ounces, from M. F. Pierson, Seneca Castle, N. Y.

April 20. One package Excelsior hulless oats; one of naked or hulless barley, and one Pride of the North corn, from M. F. Pierson, Seneca Castle, N. Y.

October 3. One sample Zurphus wheat, from M. F. Pierson, Seneca Castle, N. Y.

May 3. One package of seed corn, from I. Dillenbeck, Stanley, N. Y.

May 10. One package of husk corn, sometimes known as Oregon corn, wild corn, Paraguay corn, etc., from Prof. W. J. Beal, Lansing, Mich.

June 1. Two packages of Minnesota Dent corn, from Milton B. Jarvis, Canastota, N. Y.

June 3. One package each of Early Dent, Blount's Prolific, Improved King Philip, Chester County Mammoth, Sibley's Pride of the

North, Egyptian Joint Parching, and Rice Parching corn, from Hiram Sibley & Co., seedsmen, Rochester, N. Y.

June 19. One package of huckleberry seed, from John R. Kane, Sumpter Court House, S. C.

September 21. Four quarts of two-rowed Scotch barley, from A. D. Baker, Aurelius, N. Y.

September 26. One package each of the following varieties of winter wheat: Champion Amber, German Amber, Red Amber, California Blue Stem, White Blue Stem, Yellow Blue Stem, Hungarian White Chaff, Silver Chaff, Velvet Chaff, York White Chaff, Clawson, Egyptian, Finley, Fultz, Golden Straw, Grecian, Lancaster, Mediterranean, Rice, Russian May, Russian Number Two, Sandemiska, Scott, Smooth Scott, Swift's Improved, Swamp, Tappahannock, Theiss, Travis, Treadwell, Treadwell Bearded, Washington Glass, White Eldorado, and Zimmermann, also Russian spring wheat, from Prof. W. R. Lazenby, Columbus, Ohio.

November 11. One large box of ear corn, in varieties, for museum, and fifty-one bottles of named grass seed, from Prof. W. J. Beal, Lansing, Mich.

November 27. One dozen varieties of ear corn, from F. C. Lowman, Nicholas, N. Y.

December 6. Two packets of Carica papaya seed, from Wm. S. Allen, Key West, Fla.

December 16. One packet each of Horsford, Rochester, and No. 0 tomato seed; also one packet each of Horsford's Market Garden and Racket peas; also one packet each of Black Champion oats, and of a new hybrid barley, from F. H. Horsford, Charlotte, Vt.

The following books and pamphlets have been received:

March 24. Experiments in Amber Cane and the Ensilage of Fodders at the Experimental Farm, Madison, Wis. Eight vo.; Madison, 1882; pages, 78; from Prof. W. A. Henry, Madison, Wis.

March 29. First and Second Annual Reports of the New Jersey State Agricultural Experiment Station, for the years 1880 and 1881' and also various Bulletins, from Prof. Geo. H. Cook, New Brunswick, N. J.

April 12. Tenth Census of the United States, 1880; population, Part I.

Statistics of the Iron and Steel Production of the United States.

Statistics of the Production of Precious Metals in the United States.

Social Statistics of Cities; History of the Present Condition of New Orleans, La., and Report of the City of Austin, Texas.

Extra Census Bulletin Report of the Cotton Production of the State of Louisiana, from Hon. J. W. Wadsworth, M. C.

May 31. Bulletin of the United States National Museum No. 22; Guide to the Flora of Washington and Vicinity.

United States Entomological Commission Bulletin, No. 3; The Cotton Worm, by Chas. V. Riley, M. A., Ph. D.

United States Entomological Commission Bulletin, No. 6; General Index and Supplement to the Nine Reports on the Insects of Missouri, by Chas. V. Riley, M. A., Ph. D.

United States Entomological Commission Bulletin, No. 7; Insects Injurious to Forest and Shade Trees, by A. S. Packard, Jr., M. D.

Department of the Interior, Second Report of the United States Entomological Commission on the Rocky Mountain Locust, 1878 and 1879, from Hon J. W. Wadsworth, M. C.

May 15. The Insects of the Clover Plant. A new principle in protection from inseot attacks, from J. A. Lintner, Albany, N. Y.

May 18. Eleven volumes of Michigan Pomological Society Reports, forming a complete set, from Chas. W. Garfield, Grand Rapids, Mich.

May 25. Annual Reports of the North-Carolina Agricultural Experiment Station for 1879, 1880 and 1881, also miscellaneous pamphlets, from Dr. Chas. W. Dabney, Jr., Raleigh, S. C.

June 3. Census of the State of New York, 1875, from Samuel G. Hart, Geneva, N. Y.

June 29. Transactions of the Massachusetts Horticultural Society, for the year 1881, Part 2, from Robert Manning, Salem, Mass.

July 3. Experiments and Investigations Conducted at the Pennsylvania State College, 1881–2, from Prof. W. H. Jordan, State College, Penn.

December 7. Annual Report of the Public Gardens and Plantations of Jamaica, in 1881, from D. Morris, director.

Annual Report of the Board of Regents of the Smithsonian Institution for 1880, from Prof. Spencer F. Baird, secretary.

December 30. Landreth's Prize Essays on Onion Culture, from D. Landreth & Sons.

Other gifts have been received:

March 29. One sample corn-stalk sugar, made at the department of agriculture in 1879, and three samples of sorghum sugar, made at the department of agriculture in 1879, 1880 and 1881, from Prof. Peter Collier, Washington, D. C.

April 12. Three samples of sorghum sugar and one of sorghum syrup, made at the Wisconsin Agricultural College, 1881, from Robert J. Swan, Geneva, N. Y.

April 13. One ton soluble Pacific guano, from H. D. Woodruff, agent, Auburn, N. Y.

May 2. Garden pencils, from Daniel Batchelor, seedsman, Utica, N. Y.

Wheat.

On taking possession of the Station farm March 1, a field of wheat, variety unknown, was found sown partly in single, partly in double or cross drills, together with herds grass. Two bushels of seed were said to have been used per acre. Winter killing rendered the field of uneven plant, and we were unable to find any successive areas of equal appearance. If experiments were to be essayed such must evidently be those relating to spring treatment. Recorded experience, as gleaned from various publications, all testified that spring interference could only be justifiable on rapidly growing and vigorous plants; here lack of vigor and irregularity of the plant caused by winter-killing seemed to render area comparison of uncertain value. Yet, in the hope that something of value might be learned through noting plant changes, we staked out the level portion of the field into nine full plats of one-

tenth acre each, and nine half plats of one-twentieth acre each. These plats were two rods north and south and eight rods east and west for the whole, and four rods east and west for the half plats. Plats 1 to 5 were the most uniform in appearance. On April 4 each wheat plant on plats 3 and 9 was trampled; on April 7 and 8 spaded plat 4 so as to obliterate four drills and leave two; spaded in like manner plat 13 and trampled the plants left; and on April 14 spaded in like manner plat 14, but rolled the spaded portion immediately with a garden roller, so that two rollings lapped in the central line of the spaded portion. April 17 harrowed plats 2, 7, 11 and 16 with Thomas Smoothing Harrow, lengthwise the rows, the harrow weighted by a man riding and rolling plats 11 and 16 after the harrowing. No especial care was exercised to preserve the plants. May 15 plats 10 and 17 were mown, the wheat being from ten to eleven inches tall. During growth we were unable to find sufficient difference, to be ascribed to treatment, to deserve noting.

The crops were cradled on July 19 and 20, and it was noted that on

10	11	12	13	14	15	16	17	18
1	2	3	4	5	6	7	8	9

plats 4, 13 and 14 the heads were slightly larger than in the other plats. On plats 10 and 17 the heads were noted as being short and green.

Threshed August 8 and yield noted.

Plat 1. Single drilled, not interfered with. Yield, 207½ lbs. grain, 234 lbs straw.

Plat 2. Single drilled. Harrowed. Yield, 188½ lbs. grain, 228 lbs. straw.

Plat 3. Single drilled. Trampled. Yield, 179¾ lbs. grain, 232 lbs. straw.

Plat 4. Single drilled. Four rows obliterated by spading. Yield, 93 lbs. grain, 115 lbs. straw.

Plat 5. Single drilled. Not interfered with. Yield, 219¾ lbs. grain, 276 lbs. straw.

Plat 6. Partly single, partly cross drilled. Not interfered with. Yield, 230¼ lbs. grain, 316 lbs. straw.

Plat 7. Cross drilled. Harrowed. Yield, 252¾ lbs. grain, 367 lbs. straw.

Plat 8. Cross drilled. Not interfered with. Yield, 237¼ lbs. grain, 304 lbs. straw.

Plat 9. Cross drilled. Trampled. Yield, 233¾ lbs. grain, 325 lbs. straw.

Plat 10. Single drilled. Mown. Yield, 65¾ lbs. grain, 102 lbs. straw.

Plat 11. Single drilled. Harrowed and rolled. Yield, 80½ lbs. grain, 100 lbs. straw.

Plat 12. Single drilled. Not interfered with. Yield, 87 lbs. grain, 108 lbs. straw.

Plat 13. Single-drilled. Four rows spaded up and two rows left trampled. Yield, 43 lbs. grain, 57 lbs. straw.

Plat 14. Single-drilled. Four rows spaded up and the two rows left. The spaces rolled. Yield, 64¼ lbs. grain, 76 lbs. straw.

Plat 15. Partly single, partly cross-drilled. Not interfered with. Yield, 111¾ lbs. grain, 148 lbs. straw.

Plat 16. Cross-drilled. Harrowed and rolled. Yield, 102½ lbs. grain, 139 lbs. straw.

Plat 17. Cross-drilled. Mown. Yield, 79 lbs. grain, 110 lbs. straw.

Plat 18. Cross-drilled. Not interfered with. Yield, 96¾ lbs. grain, 140 lbs. straw.

Calculating these results per acre we have:

Plat.	Grain, bush.	Straw, lbs.
1	34·5	2340
2	31·4	2289
3	29·9	2320
4	15·5	1150
5	36·6	2760
6	38·3	3160
7	42·1	3670
8	39·5	2372
9	38·9	3250
10	21·9	2040
11	26·8	2000
12	29·0	2160
13	14·3	1148
14	21·4	1520
15	37·3	2960
16	34·1	2780
17	26·2	2200
18	32·2	2800

If we arrange these figures in another form we have:

Yield of single-drilled plats, 1, 2, 3, 5, 10 and 12, 30·2 bushels grain; 2290 pounds straw per acre.

Yield of partly cross-drilled plats 6 and 15, 37·8 bushels grain; 3060 pounds straw per acre.

Yield of cross-drilled plats 7, 8, 9, 16, 17, 18, 35·5 bushels grain; 2845 pounds straw per acre.

Thus indicating a gain for the practice of cross-drilling the seed.

Yield of undisturbed plats, 34·5 bushels, 36·6 bushels, and 29·0 bushels for the single-drilled, 39·5 bushels, and 32·2 bushels for the cross-drilled, or averaging 33 bushels for the one, as against 35·8 bushels for the other, again indicating an advantage in favor of cross-drilling.

Yield of harrowed plats 2 and 7, 31·4 bushels and 42·1 bushels, or an average of 36·7 bushels as against the average of 33 bushels, and 35·8 bushels for the undisturbed plats.

It seems to us as if the teachings of this experiment are against the system employed, rather than deciding as to the advantages of the various interferences pursued. The only conclusions we are willing to

draw are in the nature of probabilities, as indicated above, or repeating ourselves, a probable gain to be ascribed to cross-drilling seed, and a probable gain from harrowing the plats in the spring.

Although the wheat field in the spring offered little prospect of large yield, yet the cool and showery weather which lasted during May and June caused the plants to tiller and so occupy the ground as to give not only the impression of large yield, but the actual yield as tested by the thresher.

BARLEY.

As we were unable to sow spring grains in the ordinary way, we had need to be content with sowing our barley in drill two feet apart, the seed being strewn thinly and uniformly along the rows. The seed was procured from seedsmen, a variety of each named variety that we saw in the seed catalogues. Single rows of each variety were heavily cultivated on both sides, and single rows received like cultivation upon one side only, the implement used being the spade. It was designed to make this cultivation excessive; and to injure the plants, if this were possible. The weeds were kept down throughout the whole area planted, by frequent pulling and occasionally use of the hoe.

The following is the summary of progress and yield:

Variety.	Planted.	Vegetated.	Days.	Bloomed.	Days.	Ripe.	Days.
Naked or hulless....	Apr. 17	May 1	14	June 20	64	July 29	113
Two-rowed.........	Apr. 17	May 1	14	June 26	70	July 31	115
Four-rowed.........	Apr. 17	May 2	15	June 20	64	July 28	112
Kinvers' Chevalier..	Apr. 17	May 2	15	July 3	77	Aug. 11	126

The yield were as below, per row, and calculated to the acre:

	Spaded 100 ft. row,		Half-spaded 75 ft. row,		Unspaded 100 ft. row,	
	per row.	per acre.	per row.	per acre.	per row.	per acre.
Naked or hulless...	6 11-16 lbs.,	30.3 bu.	5 7- 8 lbs.,	35.4 bu.	7 9-16 lbs.,	34.3 bu.
Two-rowed........	9 7-16 lbs.,	42.8 bu.	6 21-32 lbs.,	40.2 bu.	9 lbs.,	40.8 bu.
Four-rowed........	8 9-16 lbs.,	38.8 bu.	7 7-33 lbs.,	43.6 bu.	9 3- 4 lbs.,	44.2 bu.
Knivers' Chevalier.	8 3- 8 lbs.,	38.0 bu.	7 lbs.,	42.2 bu.	8 9-16 lbs.,	38.8 bu.

The rows of two-rowed and four rowed, half-spaded were 50 feet long, and have been calculated to 75 feet, in order to correspond with the others in the table.

The yield of straw per row, as above and calculated per acre, are as follows,

	Spaded 100 ft. row,		Half-spaded 100 ft. row,		Unspaded 100 ft. row,	
	per row.	per acre.	per row.	per acre.	per row.	per acre.
Naked or hulless...	4 1-2 lbs.,	980 lbs.	....		7 1-2 lbs.,	1633 lbs.
Two-rowed........	9 1-4 lbs.,	2014 lbs.	5 lbs.,	1452 lbs.	9 1-4 lbs.,	2014 lbs.
Four-rowed........	5 lbs.,	1089 lbs.	3 lbs.,	1089 lbs.	7 lbs.,	1524 lbs.
Kinvers' Chevalier.	11 3-4 lbs.,	2559 lbs.	....		12 lbs.,	2613 lbs.

The results are rather contradictory. In grain, the spaded yielded the largest crop in the two-rowed variety; the half-spaded yielded the

largest crop in the naked, hulless, and Kinvers' Chevalier; the unspaded yielded the largest crop in the four-rowed variety. If we class the spaded and half-spaded together as *cultivated*, and the unspaded as *uncultivated*, we have:

Grain.

	Cultivated.	Uncultivated.
Naked or hulless	32.8 bu.	34.3 bu.
Two-rowed	41.5 bu.	40.8 bu.
Four-rowed	41.2 bu.	44.2 bu.
Kinver's Chevalier	40.1 bu.	38.8 bu.

Straw.

	Cultivated.	Uncultivated.
Naked or hulless	980 lbs.	1633 lbs.
Two-rowed	1732 lbs.	2014 lbs.
Four-rowed	1089 lbs.	1524 lbs.
Kinver's Chevalier	2559 lbs.	2613 lbs.

We may infer from these figures, that, under circumstances of wide intervals and thin seeding, cultivation carried to an extreme can be pronounced as neither advantageous nor injurious to the grain yield, but as tending decidedly to reduce the straw.

OATS.

Sample of every variety of oats that could be obtained from seedsmen were sown in drills two feet apart, the seed evenly and thinly scattered in the row. The tabulated records are as below :

	Planted.	Vegetated.	Days.	Bloomed.	Days.	Ripe.	Days.
Bohemian or hulless	Apr. 17	May 2	15	July 3	77	Aug. 1	106
Chinese hulless	Apr. 15	May 1	16	June 30	76	Aug. 3	110
Pringle's Excelsior Hulless	Apr. 15	May 1	16	June 30	76	Aug. 5	112
Mold's Ennobled	Apr. 15	May 1	16	June 30	76	Aug. 5	112
Mammoth Russian	Apr. 15	May 1	16	June 30	76	Aug. 5	112
Washington (Thorburn)	Apr. 15	May 1	16	July 3	79	Aug. 5	112
Washington (Bliss)	Apr. 15	May 1	16	July 3	79	Aug. 5	112
New Australian	Apr. 15	May 1	16	....	..	Aug. 9	116
Challenge	Apr. 17	May 2	15	July 14	88	Aug. 11	116
White Russian	Apr. 15	May 1	16	July 14	86	Aug. 19	126

As a matter of curiosity, we selected three of the most prolific stems of each variety, and, by means of the balance, determined the heaviest of each three, whose spikelets and seeds were then carefully counted, with the following result:

	Spikelets.	Seed.
Bohemian or Hulless	71	136
Chinese Hulless	63	112
Pringle's Excelsior Hulless	91	137
Mold's Ennobled	28	72
Mammoth Russian	80	131
Washington (Thornton)	132	143
Washington (Bliss)	153	210
New Australian	189	254
Challenge	115	201
White Russian	83	123

Portions of each variety received spade cultivation on both sides of the drills, other portions on but one side of the drills, while still other portions were left unspaded; the design being to study the effect of excessive cultivation upon the plant. The weeds throughout the plants were kept down by pulling and by the use of the hoe.

The yields per row and calculated per acre were as below. The rows being 100 and 200 feet, but calculated alike to 100 feet. The Bohemian had but 75 feet of row spaded :

Grain.

	Spaded.	
	Per 100 feet row.	Per acre.
Bohemian or Hulless	3 lbs. 13¼ ozs.	26 bush.
Chinese Hulless	....	....
Pringle's Excelsior Hulless	5 lbs. 12 ozs.	39·1 bush.
Mold's Ennobled	....	....
Mammoth Russian	7 lbs. 10¼ ozs.	52·0 bush.
Washington (Thorburn)	6 lbs. 15 ozs.	47·2 bush.
Washington (Bliss)	8 lbs. 13½ ozs.	60·2 bush.
New Australian	7 lbs. 2½ ozs.	48·7 bush.
Challenge	6 lbs. 12¾ ozs.	46·2 bush.
White Russian	8 lbs. 12 ozs.	59·5 bush.

	Half-spaded.	
	Per 100 feet row.	Per acre.
Bohemian or Hulless	3 lbs. 14½ ozs.	26·5 bush.
Chinese Hulless	....	....
Pringle's Excelsior Hulless	5 lbs. 2¼ ozs.	34·9 bush.
Mold's Ennobled	7 lbs. 8¼ ozs.	51·1 bush.
Mammoth Russian	8 lbs. 5½ ozs.	56·7 bush.
Washington (Thorburn)	8 lbs. 7¾ ozs.	57·7 bush.
Washington (Bliss)	9 lbs. 13¼ ozs.	66.9 bush.
New Australian	7 lbs. 10 ozs.	51·9 bush.
Challenge	6 lbs. 12½ ozs.	46·1 bush.
White Russian	9 lbs. 9½ ozs.	65·3 bush.

	Unspaded.	
	Per 100 feet row.	Per acre.
Bohemian or Hulless	....	....
Chinese Hulless	4 lbs. 4⅛ ozs.	29·0 bush.
Pringle's Excelsior Hulless	5 lbs. 3⅝ ozs.	35·5 bush.
Mold's Ennobled	9 lbs. 12½ ozs.	66·5 bush.
Mammoth Russian	7 lbs. 4½ ozs.	49·5 bush.
Washington (Thorburn)	9 lbs. 2 ozs.	62·2 bush.
Washington (Bliss)	9 lbs. 11½ ozs.	66·1 bush.
New Australian	7 lbs. 12 ozs.	52·7 bush.
Challenge	6 lbs. 5½ ozs.	43·2 bush.
White Russian	8 lbs. 13¼ ozs.	60·0 bush.

Straw.

	Spaded. Per row.	Per acre.
Bohemian or Hulless	9 lbs.	1960 lbs.
Chinese Hulless	10·2 lbs.	2232 lbs.
Pringle's Excelsior Hulless	9·5 lbs.	2069 lbs.
Mold's Ennobled	8·0 lbs.	1742 lbs.
Mammoth Russian	8·5 lbs.	1851 lbs.
Washington (Thorburn)	10·5 lbs.	2287 lbs.
Washington (Bliss)	12·0 lbs.	2613 lbs.
New Australian	9·2 lbs.	2014 lbs.
Challenge	12·8 lbs.	2804 lbs.
White Russian	14·5 lbs.	3158 lbs.

	Half-spaded. Per row.	Per acre.
Bohemian or Hulless	10·6 lbs.	2320 lbs.
Chinese Hulless	9·0 lbs.	1960 lbs.
Pringle's Excelsior Hulless	12·0 lbs.	2613 lbs.
Mold's Ennobled	8·5 lbs.	1851 lbs.
Mammoth Russian	8·5 lbs.	1851 lbs.
Washington (Thorburn)	12·5 lbs.	2722 lbs.
Washington (Bliss)	12·0 lbs.	2613 lbs.
New Australian	10·0 lbs.	2178 lbs.
Challenge	10·5 lbs.	2287 lbs.
White Russian	14·0 lbs.	3049 lbs.

	Unspaded. Per row.	Per acre.
Bohemian or Hulless	....	....
Chinese Hulless	10·5 lbs.	2287 lbs.
Pringle's Excelsior Hulless	10·0 lbs.	2178 lbs.
Mold's Ennobled	9·5 lbs.	2069 lbs.
Mammoth Russian	9·5 lbs.	2069 lbs.
Washington (Thorburn)	11·0 lbs.	2395 lbs.
Washington (Bliss)	12·5 lbs.	2722 lbs.
New Australian	11·5 lbs.	2504 lbs.
Challenge	12·2 lbs.	2668 lbs.
White Russian	13·2 lbs.	2885 lbs.

The Hulless varieties shelled so badly during the process of harvesting that the figures of their yield are far below the true prolificacy of the plants. Omitting this class of oats from our comparison, we may refer to various facts as brought out by our table.

Out of the twenty plats, six spaded, seven half-spaded and seven not spaded, the average grain yield for the spaded was 52.3 bushels per acre; for the half-spaded, 56.5 bushels per acre; for the unspaded, 57.1 bushels per acre. The average yield of straw for the same plats was 1.227 tons, 1.182 tons and 1.236 tons per acre. The average proportion between grain and straw was as 1 bushel : 47 lbs.; 1 bushel : 42 lbs., and 1 bushel : 43 lbs.

The extremes and the average yield of grain for the varieties was :

	Extremes.	Average.
Mold's Ennobled..................	51.1—66.5	58.8 bushels.
Mammoth Russian	49.5—56.7	52.7 "
Washington (Thorburn)	47.2—62.2	55.7 "
Washington (Bliss)................	60.2—66.9	64.4 "
New Australian....................	48.7—52.7	51.1 "
Challenge	43.2—46.2	45.1 "
White Russian	59.5—65.3	61.6 "

The greatest variation between the yields of twenty plats was 43.2 and 66.9 or 23.7 bushels. The greatest variation between the average yield of the varieties was 45.1 and 64.4, or 19.3 bushels. The same variety, the seed procured from two different sources, the Washington oat, varied, however, from 55.7 to 64.4 bushels, or 8.7 bushels as the average of the three trials of each sample, and varied between the three plats 15 bushels in one case, and 6.7 bushels in the other. This variation of 8.7 bushels between the two samples of Washington oats was greater than in several cases occurred between the varieties.

If we ask how much these variations were due to the excessive cultivation, we find results comparatively contradictory. Of the twenty yields distributed among the seven samples treated as varieties, in one case only, that of the Challenge, was the yield the greatest upon the spaded portion. In three cases, that of the Mammoth Russian, Washington (Bliss) and White Russian, the yield was greatest upon the half-spaded portion. In three cases, that of Mold's Ennobled, Washington (Thorburn) and New Australian, the yield was greatest upon the uncultivated portion.

MAIZE.

These figures of the corn experiments offer material for each one interested to study out for himself. We may call attention in brief to a few points which seem strongly indicated. First, that the season was too unfavorable for corn for us to obtain in any one instance a large yield. It is probable that under these circumstances the differences between seed, which in a favorable year would have become manifest, in this year became obscured. Second, that fertilizer exerted but little influence in the presence of the cool summer. Third, that fertilizer was unable to overcome a physical incapacity of soil. Fourth, that fertilizer improved the quality of crop, even when it did not seem to react upon the quantity. Fifth, that the effect of cultivation may be variable according to the conditions under which it takes place. Sixth, the necessity of other experiments than the plat system in order to gain results which can be interpreted in a trustworthy manner.

In our sorting of the corn crop the term "unmerchantable corn" has a special meaning. The division into merchantable and unmerchantable has usually reference to the sale of the ear corn, *i. e.*, appeals to the sight. With the exception of the late ripening corn we may say there was practically no soft corn — but very little corn but that if shelled would become merchantable.

In calculating our weights to the bushel yield we have allowed 80 pounds of ear corn to the bushel of merchantable grain, unless otherwise

stated. A determination of the water in the ear corn shows that this is an ample allowance. Thus, the corn taken from the pile as husked gave 27.3 pounds of water to the 100 pounds of ear corn. Calculating from the ear corn as husked to the air-dry corn, containing fourteen per cent of water, we find that the husked corn furnished 72.45 per cent of air-dry corn, or eighty pounds of ear corn would shell out fifty-eight pounds of shelled corn.

The corn was planted upon plats of one-tenth acre and one-twentieth acre area, the size in every case being 2 x 4 rods or 2 x 8 rods, the length being north and south. The series count from north to south, the numbers from west to east. The following are particulars for each plat, from which the tabulated results elsewhere given are calculated: The fertilizer used, Bowker's hill and drill phosphate.

Series 1 A planted with Waushakum corn, hills 42 x 44 inches, six kernels in a hill thinned to four. The upper half left uncultivated, the lower half cultivated in the ordinary manner. The fertilizing per acre and actual yield as below:

Ear corn.

	Fertilizer.			Good.	Poor.	Total.
1.	0	Uncultivated half	1-20 a.	219 lbs.	3 1-4 lbs.	222 1-4 lbs.
		Cultivated half	"	199 1-2 lbs.	3 1-4 lbs.	202 3-4 lbs.
2.	200 lbs.	Uncultivated half	"	215 1-4 lbs.	14 lbs.	229 1-4 lbs.
		Cultivated half	"	180 lbs.	9 1-2 lbs.	189 1-2 lbs.
3.	400 lbs.	Uncultivated half	"	222 lbs.	11 3-4 lbs.	233 3-4 lbs.
		Cultivated half	"	199 lbs.	6 lbs.	205 lbs.
4.	800 lbs.	Uncultivated half	"	234 lbs.	5 lbs.	239 lbs.
		Cultivated half	"	227 1-4 lbs.	3 lbs.	230 1-2 lbs.
5.	1600 lbs.	Uncultivated half	"	231 lbs.	3 lbs.	224 lbs.
		Cultivated half	"	227 lbs.	4 lbs.	231 lbs.
	Total for half acre			2154 lbs.	62 3-4 lbs.	2216 3-4 lbs.

Series 2 A was planted with corn from Willow Brook, New York, described to us as bearing the local name of Turners—somewhat mixed—raised by one man for twenty-two years, seventeen years on the same place. Yield last year twenty bushels per acre, as estimated. The plats planted and treated as series 1 A. The figures as below:

Ear corn.

	Fertilizer.			Good.	Poor.	Total.
1.	200 lbs.	Uncultivated half	1-20 a.	189 1-4 lbs.	15 1-2 lbs.	204 3-4 lbs.
		Cultivated half	"	135 1-2 lbs.	26 3-4 lbs.	162 1-4 lbs.
2.	400 lbs.	Uncultivated half	"	195 lbs.	14 1-2 lbs.	209 1-2 lbs.
		Cultivated half	"	211 lbs.	9 1-4 lbs.	220 1-4 lbs.
3.	800 lbs.	Uncultivated half	"	195 lbs.	17 1-2 lbs.	212 1-2 lbs.
		Cultivated half	"	191 1-2 lbs.	9 3-4 lbs.	201 1-4 lbs.
4.	1600 lbs.	Uncultivated half	"	203 lbs.	8 3-4 lbs.	211 3-4 lbs.
		Cultivated half	"	190 lbs.	15 lbs.	205 lbs.
5.	0 lbs.	Uncultivated half	"	154 lbs.	26 1-4 lbs.	180 1-4 lbs.
		Cultivated half	"	194 1-2 lbs.	9 lbs.	203 1-2 lbs.
	Total for half acre			1858 3-4 lbs.	152 1-4 lbs.	2011 lbs.

Series 1 B was planted with corn from Elmira, the seed being selected from an unprolific crop. The details of planting, culture, etc., being as in series 1 A and 2 A. The figures are as below:

Fertilizer.				Good.	Poor.	Total.
1.	0 lbs.	Cultivated half	1-20 a.	207 3-4 lbs.	5 3-4 lbs.	213 1-2 lbs.
		Uncultivated half	"	137 3-4 lbs.	13 3-4 lbs.	151 1-2 lbs.
2.	200 lbs.	Cultivated half	"	213 lbs.	4 1-4 lbs.	217 1-4 lbs.
		Uncultivated half	"	105 3-4 lbs.	15 1-2 lbs.	121 1-4 lbs.
3.	400 lbs.	Cultivated half	"	233 1-2 lbs.	2 1-4 lbs.	235 3-4 lbs.
		Uncultivated half	"	111 lbs.	13 1-2 lbs.	124 1-2 lbs.
4.	800 lbs.	Cultivated half	"	207 1-2 lbs.	3 1-2 lbs.	211 lbs.
		Uncultivated half	"	233 1-2 lbs.	4 lbs.	237 1-2 lbs.
5.	1600 lbs.	Cultivated half	"	254 3-4 lbs.	2 1-4 lbs.	257 lbs.
		Uncultivated half	"	239 lbs.	3 lbs.	242 lbs.
Total for half acre				1943 1-2 lbs.	67 3-4 lbs.	2011 1-4 lbs.

Series 2 B was planted with Waushakum seed, otherwise as in series 1 A, 2 A, and 1 B. The figures of the crop are given below:

Fertilizer.				Good.	Poor.	Total.
1.	200 lbs.	Cultivated half	1-20 a.	207 1-4 lbs.	5 3-4 lbs.	213 lbs.
		Uncultivated half	"	162 1-2 lbs.	7 1-2 lbs.	170 lbs.
2.	400 lbs.	Cultivated half	"	206 1-2 lbs.	6 1-4 lbs.	212 3-4 lbs.
		Uncultivated half	"	176 1-4 lbs.	6 lbs.	182 1-4 lbs.
3.	800 lbs.	Cultivated half	"	224 1-2 lbs.	1 1-2 lbs.	226 lbs.
		Uncultivated half	"	197 3-4 lbs.	3 lbs.	200 3-4 lbs.
4.	1600 lbs.	Cultivated half	"	221 1-4 lbs.	3 lbs.	224 1-4 lbs.
		Uncultivated half	"	221 1-2 lbs.	1 lbs.	222 1-2 lbs.
5.	0 lbs.	Cultivated half	"	208 1-4 lbs.	4 3-4 lbs.	213 lbs.
		Uncultivated half	"	181 lbs.	4 1-4 lbs.	185 1-4 lbs.
Total for half-acre				2000 3-4 lbs.	48 lbs.	2049 3-4 lbs.

The corn seed on these series, 1 A, 2 A, 1 B, 2 B, was all of the yellow flint type, and the kernels hard and of excellent quality, the four series forming one system.

Plat 3 A was planted with Waushakum corn, twelve of the most perfect ears obtainable, furnishing the seed. The hills 42 x 44 inches, six kernels planted, afterward thinned to four. The upper 1-20 acre uncultivated, the lower cultivated. The fertilizer used eight hundred pounds per acre of Bowker's Hill and Drill. The yield was,

	Good.	Poor.	Total.
Uncultivated portion, 1-20 acre	175 1-2 lbs.	31 1-2 lbs.	207 lbs.
Cultivated portion, 1-20 acre	217 3-4 lbs.	22 1-2 lbs.	340 1-4 lbs.

Plat 3 B, the same as 3 A, but a bushel of twisted, gnarled, imperfect ears taken, and from those ears shelled, enough good appearing kernels taken for seed. The yields were :

	Good.	Poor.	Total.
Cultivated portion, 1-20 acre	179 1-2 lbs.	28 lbs.	207 1-2 lbs.
Uncultivated portion, 1-20 acre	189 1-2 lbs.	26 1-2 lbs.	216 lbs.

Plat 4 A. The upper half receiving no fertilizer, the lower half four hundred pounds per acre of Bowker's Hill and Drill. Upon each portion was planted the seed from an ear of corn, in drills forty-four inches apart, each kernel holding the position it occupied upon its cob. The intention being to observe the difference, if any, between the butt, tip and central kernels used as seed. The results are given in the following table :

	Upper Plat.			Lower Plat.		
Row.	No. of kernels planted.	No. vegetated.	Yield good corn.	No. of kernels planted.	No. vegetated.	Yield good corn.
1.	55	50	18 lbs. 11 1-2 ozs.	44	41	21 lbs. 15 1-4 ozs.
2.	52	47	12 lbs. 15 1-4 ozs.	42	41	20 lbs. 6 ozs.
3.	53	49	12 lbs. 6 1-2 ozs.	42	41	19 lbs. 8 1-4 ozs.
4.	51	46	12 lbs. 0 ozs.	41	39	17 lbs. 13 ozs.
5.	54	50	16 lbs. 2 ozs.	43	43	19 lbs. 14 1-2 ozs.
6.	55	48	14 lbs. 15 1-2 ozs.	45	43	19 lbs. 13 ozs.
7.	54	48	15 lbs. 10 ozs.	43	43	18 lbs. 14 1-4 ozs.
8.	52	50	16 lbs. 2 1-2 ozs.	45	44	22 lbs. 2 ozs.

	Good ears.	Poor ears.	Length of ears.	Good ears.	Poor ears.	Length of ears.
1.	45	20	407 1-2 in.	49	10	419 in.
2.	37	8	295 in.	47	9	375 in.
3.	35	10	265 1-2 in.	40	6	340 1-2 in.
4.	33	10	252 1-2 in.	41	5	323 in.
5.	40	11	312 in.	47	6	376 in.
6.	39	24	327 in.	47	7	371 in.
7.	31	12	331 in.	46	3	359 in.
8.	39	11	317 in.	48	6	395 in.

The first five butt kernels gave the following results:

	Upper Plat.	Lower Plat.
Number of kernels planted	40	40
Number vegetated	17	39
Good ears	19	44
Poor ears	10	11
Length of ears	219 1-2 in.	365 in.
Weight of good ear-corn	8 lbs. 4 oz.	20 lbs. 2 1-4 oz.

The central kernels offer the following figures:

	Upper Plat.	Lower Plat.
Number kernels planted	346	265
Number vegetated	333	256
Good ears	244	274
Poor ears	89	36
Length of ears	1849 in.	2201 in.
Weight of good ear-corn	92 lbs. 14 oz.	119 lbs. 14 1-2 oz.

The first five tip kernels offered figures as below:

	Upper Plat.	Lower Plat.
Number kernels planted	40	40
Number vegetated	38	40
Good ears	46	47
Poor ears	8	5
Length of ears	439 in.	392 1-2 in.
Weight of good ear-corn	17 lbs. 11 1-4 oz.	21 lbs. 6 1-4 oz.

Plat 4 B was planted in drills forty-four inches apart. Waushakum corn, the upper half, single kernels each a foot apart in the drill, the lower portion four kernels in a place. The fertilizer, Bowker's Hill and Drill, 400 pounds per acre. The yield as below:

	Good.	Poor.	Total.
Upper portion, 1-20 acre	206 lbs.	6 1-4 lbs.	212 1-4 lbs.
Lower portion, 1-20 acre	56 1-2 lbs.	59 1-2 lbs.	116 lbs.

Plat 5 A. The seed used, Waushakum. The fertilizer as 4 B. The upper portion planted single kernels one foot apart, the lower portion planted six kernels, afterward thinned to four, two feet apart. The yield was:

	Good	Poor.	Total.
Upper portion, 1-20 acre ..	23 1-4 lbs.	44 lbs.	67 1-4 lbs.
Lower portion, 1-20 acre ..	28 lbs.	46 1-2 lbs.	74 1-2 lbs.

Plat 5 B, same as 5 A, but the upper half planted three feet apart, the lower four feet apart. Six kernels in a hill, afterward thinned to four. The yield was:

	Good.	Poor.	Total.
Upper portion...........	195 lbs.	21 1-4 lbs.	216 1-4 lbs.
Lower portion...........	143 1-2 lbs.	10 lbs.	153 1-2 lbs.

Plat 6 A. To test depth of planting. The seed, Waushakum. Nine rows planted, the seventy-six seed dibbled in, six kernels in a place, in the first row, one-quarter inch deep, the next row, one inch, next, 2 inches, etc., to eight inches deep. The figures are as below:

Row.	Depth of planting.	Hills planted.	Hills vegetated.	Kernels vegetated.*	Yield of ear-corn.
1	¼ in.	19	19	76	23 lbs.
2	1 "	19	19	76	20¼ "
3	2 "	19	19	68	17½ "
4	3 "	19	19	61	17¼ "
5	4 "	19	19	76	19½ "
6	5 "	19	19	66	18 "
7	6 "	19	19	59	16¼ "
8	7 "	19	15	48	14¼ "
9	8 "	19	17	50	16¼ "

No difference observed in the quality of the yield planted June 2, the first and second rows vegetated June 12, the third row on June 13, and the remaining rows vegetated all together on June 16.

Series C was laid out in one-twentieth acre plats, and planted with corn under various circumstances of fertilizing and seed.

C 1 received 150 cubic feet of yard dung and 50 pounds of fertilizer. Waushakum corn used for seed, six kernels dibbled in hills 42x44 inches apart, and afterward thinned to four. The yield, 163 1-4 pounds good ear-corn, 43 1-2 pounds of poor ear-corn; or a total yield of 207 pounds.

C 2 received manure and fertilizer and seeding same as C 1, but was severely root pruned. The yield, 170 1-4 pounds good ear-corn, and 38 3-4 pounds of poor corn; or a total of 209 pounds.

C 3 received 800 pounds per acre of fertilizer; Waushakum seed; hills 3x3 feet apart; six kernels in a hill, afterward thinned to four. The yield was 156 1-2 pounds of good ear-corn, and 39 1-4 pounds poor corn; or a total of 195 3-4 pounds.

C 4. Same as C 3, except the hills, 3x2 feet apart, and excessively root pruned. The yield was 93 pounds good ear-corn, 80 pounds of poor; or a total of 173 pounds.

* The thinnings escaped record, and the tables refer to plants left in the hill.

C 5. Same as C 3, except 1,600 pounds per acre of fertilizer was used, and the hills were 3x3 1-2 feet apart. The yield, 249 pounds good ear corn, and 13 1-2 pounds poor corn; or a total of 262 1-2 pounds.

C 6. Blount's Prolific corn; 400 pounds of fertilizer per acre ; hills 42x44 inches; six kernals in a hill, afterward thinned to four. Yield, 299 pounds; all soft and unmerchantable, not ripening.

C 7. Early Dent, and otherwise as in 6. Yield, 196 pounds; all soft.

C 8. Sibley's Pride of the North seed, otherwise as in 6 and 7. Yield, 111 1-4 pounds, merchantable, and 11 1-4 pounds unmerchantable ears.

C 9. Chester County Mammoth seed used ; otherwise as in C 6, 7 and 8. The yield was 141 pounds good ear-corn, and 34 1-4 pounds poor corn; or a total of 175 1-4 pounds.

C 10. Improved King Philip seed; otherwise as in C 6, 7, 8 9. The yield was 177 1-2 pounds good ear-corn, and 8 1-2 pounds poor corn; or a total of 186 pounds.

C 11. Seed, a Dent corn, from I. Dillenbeck, Stanley N. Y.; otherwise the same as C 6, 7, 8, 9 and 10. The yield, 337 1-2 pounds; all soft and unmerchantable.

C 12. White Flint corn, and two white beans in each hill; otherwise as the preceding. The beans, mostly destroyed by the cut worm, The yield, 1 pound and 11 ounces of beans, and 209 pounds good ear-corn, 3 pounds of poor corn; or a total, corn, 212 pounds.

C 13. White Flint corn as seed; otherwise as in C 12, but no beans. The yield, 199 1-2 pounds good ear-corn, and 3 1-4 pounds poor corn; or a total of 202 3-4 pounds.

C 14. White Flint corn as seed; otherwise as in C 13, but pumpkins planted throughout the plat. The yield, forty punkins, weighing 119 pounds; 184 pounds good ear-corn, and 6 1-2 pounds poor corn or a total of 190 1-2 pounds.

Series D was laid out in half plats, of one-twentieth acre. The first ten, marked "D 1," were used to furnish corn for mutilation, destruction, etc., in order that we could have plants for experiment without having to interfere with our plants under study.

D 2. Minnesota Dent; seed from Minnesota; 400 pounds per acre of fertilizer used ; hills 42x43 inches; six kernels to a hill, afterward thinned to four. The yield was 238 pounds good ear-corn, and 10 1-2 pounds poor ear-corn; or a total of 248 1-2 pounds.

D 3. Minnesota Dent; seed grown in New York; plat treated otherwise as in D 2. The yield, 198 pounds good ear-corn, and 8 pounds poor; or 206 pounds in all. The seed of D 2 and D 3 from Milton Y. Jarvis, Canastota, N. Y.

Two half plats were planted with pop-corn, in hills. The Egyptian Giant harvested 87 pounds of dry ear-corn, and the Rice Parching yielded 87 3-4 pounds of dry ear-corn on the twentieth acre.

Corn Experiment — Influence of Seed.

As plats 1 A and 2 B were planted with Waushakum corn, plat 2 A with Willow Brook, and plat 1 B with Elmira seed, all under corresponding conditions, we may arrange our results as below in bushels of shelled corn :

	Half acre yielded. Good.	Poor.	Total.	Yield calculated per acre. Good.	Poor.	Total.
Waushakum corn, 1 A...	26·9	·8	27·7	53·8	1·0	55·4
Waushakum corn, 2 B...	25·1	·5	25·6	50·2	1·0	51·2
Willow Brook corn, 2 A..	23·2	1·9	25·1	46·4	3·8	50·2
Elmira corn, 1 B........	24·3	·9	25·2	48·6	1·8	50·4

Arranging the results according to fertilizer used we have for merchantable yield:

	No. fertilizer.	200 lbs. fertilizer.	400 lbs. fertilizer.
Waushakum corn, 1 A..............	52·3	49·4	52·6
Waushakum corn, 2 B..............	48·7	46·2	47·7
Willow Brook corn, 2 A.............	43·6	40·6	50·7
Elmira corn, 1 B..................	43·2	39·8	43·0

	800 lbs. fertilizer.	1600 lbs. fertilizer.
Waushakum corn, 1 A	57.7	57.2
Waushakum corn, 2 B........................	52.7	55.3
Willow Brook corn, 2 A......................	48.3	49.1
Elmira corn, 1 B............................	55.1	61·7

As these seeds were selected, the Waushakum as the type of the best, and the other seed as types of the ordinary or poorest seeds that could be obtained, the results seem inexplicable except on the supposition that the climate of this year was exceptionally unfavorable to the normal growth of the plant. What lends some force to this supposition is the exceptional circumstance noted, that the corn plant shriveled but once during the summer. It is a nearly universal belief among farmers I have met that this shriveling during hot summer days is favorable to corn. The Waushakum corn has not yielded its average crop within fifty per cent, while the other corns have yielded nearly double what the former growers from whom it came have customarily received. Until the effect of climate can be investigated, and its value as a factor estimated, we shall ever be subject to the chance of misinterpreting the results of plat culture. It is to be hoped that as we gain in experience and opportunity we shall be able to estimate the changes which a given temperature and moisture produce upon given crops.

What is the influence on crop of the kind of kernel selected for seed? Is the shape of the ear transmissible, or does the shape of ear depend upon general conditions, while the kernel becomes potent only for kernel? In order to determine this question a dozen ears of Waushakum corn were selected for their perfection of kernel and shape, and an equal number of good kernels were selected from a bushel of the most twisted and distorted ears that could be obtained.

Two plats of one-tenth acre each, running north and south, and divided again into half plats were taken. The crop on one-half of each plat was lightly hoed in order to keep free from weeds, and the crop on the other half of each plat received ordinary farm cultivation. One plat received the seed from the ears selected as perfect, the other was seeded with the good seed taken from the culls selected for their in-

ferior quality. The seed was planted in hills, 42 inches by 44 inches, six seed in a hill, afterward thinned to four. Bowker's hill and drill phosphate was applied broadcast at the rate of 800 lbs. per acre. The first twenty-four rows of each plat were planted on May 27, the remaining fourteen rows on May 29, the first attempt at planting being delayed by the occurrence of rain. Vegetation occurred June 9, and the presence of weeds necessitated a hoeing, which was effected June 10. On June 23 cultivation commenced on the half plats and continued on July 8 and 13. July 27, the tassels appeared and bloom was noted on July 29. Cut and stocked September 16. October 10 husked in the field, the grain well appearing, dry and hard. Fair samples dried in the laboratory showing for the corn and ear thirteen per cent of surplus water, calculated for the thoroughly air dried crop of fourteen per cent moisture.

The yields were as follows:

Crop from perfect Ears.

	Merchantable and straight ears.	Unmerchantable and irregular ears.
Uncultivated portion............	177 1-2 lbs.	31 1-2 lbs.
Cultivated portion..............	217 3-4 lbs.	22 1-2 lbs.
Total for the tenth acre......	395 1-4 lbs.	54 lbs.

Crop from imperfect Ears.

Uncultivated portion...........	189 1-2 lbs.	26 1-2 lbs.
Cultivated portion..............	179 1-2 lbs.	28 lbs.
Total for the tenth acre......	369 lbs.	54 1-2 lbs.

Calculating these results in per cents we have:

From selected ears about fourteen per cent of irregular ears and poor corn.

From selected culls about 14 3-4 per cent of irregular ears and poor corn.

Calculating the yields per acre we have:

From selected ears, 56·5 bushels (70 lbs.) of straight corn per acre.
From selected culls, 52·7 bushels (70 lbs.) of straight corn per acre.
From selected ears, 64·1 bushels (70 lbs.) total yield per acre.
From selected culls, 60·5 bushels (70 lbs.) total yield per acre.

Upon the first plat, that planted with seed from perfect ears, the cultivated half yielded 14·3 bushels, of 70 pounds, per acre more than the uncultivated portion. Upon the second plat, seeded with grain from culls, the cultivated half yielded 2·8 bushels, of 70 pounds, per acre less than the uncultivated portion.

A careful observation of the harvested ears, by three independent observers, justify the conclusion that there was a little perceptible difference in quality or shape of ears as between the product of the plats.

Comment upon these surprising results, counter to what would *a priori* have been argued from what might have seemed in advance sufficient data, is unnecessary, and it would not be proper at this time to endeavor to draw deductions from a single trial, which, however resulting, would not suffice for generalization. And yet I am fain to say, that had the results showed generally straight ears in one case, and generally distorted in the other case, influenced by my predilections, it is quite probable that I should attempt a generalization, which now, from stronger data than I should assume, seems to my present caution insufficient.

We publish our figures: One hundred ears were taken haphazard form the merchantable ears, and these ears carefully sorted, the ears perfect at the butt, perfect at tip, etc. The computation reads, produced:

	Yield of seed from perfect ears.	Yield of seed from imperfect ears.
Of ears perfect at butt	18 per cent.	24 per cent.
Of ears slightly open at butt	34 "	36 "
Of ears manifestly imperfect	48 "	40 "
Of ears perfect at tip	18 "	25 "
Of ears imperfect at tip	82 "	75 "

BUTTS AND TIPS FOR SEED.

The custom of rejecting the butt and tip kernels from the selection of seed corn is an almost universal practice among our more careful farmers who exercise concern about their seed. In an experiment designed to determine the influence of the butt and tip kernels used as seed, normal ears of Waushakum corn were taken and planted kernel by kernel on two plats in eight rows, each kernel occupying in the row the relative position it occupied on the ear. One ear was thus diagrammed on unmanured soil, the other upon soil which received 400 pounds of Bowker's hill and drill phosphate per acre. These two plats were so situated that the butt kernels commenced upon the north and south end respectively, the kernels being planted toward the center, leaving a space of several yards between the tip kernels of each ear. The seed was planted May 31, the drills forty-two inches apart, the kernels one foot apart in the drill. It was supposed that under this method of planting any divergence of growth would become at once manifest to the eye, and change in time of bloom, or ripening, as between the product of each kernel if influenced by location of the kernel upon the cob, could be readily perceived and noted. We were able, however, to discern but little, if any, difference during growth. In the kernels on the unmanured plat fewer of the butt and tip corns vegetated than from the ear planted on the manured plat, while upon both plats the vegetation of the central kernels was nearly perfect. Vegetation appeared June 10, uniformly over both plats, on July 25 the tassels showed uniformly over the plats, on July 29, marked as in bloom, and no perceptible difference as between the centers and ends of the rows. The corn was left standing until October 5, when the director and his assistants husked each plant, laying its own yield upon the ground alongside each plant, and made the following figures:

	Unmanured. Butt.	Cent'l.	Tip.	Manured. Butt.	Cent'l.	Tip.
Kernels planted..................	40	346	40	40	265	40
Kernels vegetated..................	17	333	38	39	256	40

Thus the germinative per cent of the two ears was: 426 kernels planted, 388 grew, or 91 per cent for the ear on the unmanured soil; and 345 kernels planted, 335 grew, or 97 per cent for the ear on the manured soil. Of the 80 butt kernels, 56 kernels or 70 per cent germinated; of the 611 central kernels, 589 kernels or 96 per cent germinated; of the 80 tip kernels, 78 kernels or 97·5 per cent germinated. We may, however, conclude that in general on normal, well-selected ears, the tip and butt kernels are as likely to grow as are the central kernels, and furnish equally well-appearing plants.

We next separated the merchantable and unmerchantable corn, and obtained the following figures:

	Unmanured. Butt.	Cent'l.	Tip.	Manured. Butt.	Cent'l.	Tip.
Merchantable ears.............	19	244	46	44	274	47
Unmerchantable ears............	10	89	8	11	36	5

Re-calculating the figures in this table so as to give the yield per plant, by estimating the missing kernels as equally productive with the grain-bearing plants, we have:

	Unmanured Plat. Butt.	Central	Tip.	Manured Plat. Butt.	Central.	Tip.
Merchantable ears...........	44	253	48	45	284	47
Unmerchantable ears.........	23	92	8	11	37	5
Merchantable ears per 100 plants....................	110	73	120	112	107	117
Unmerchantable ears per 100 plants....................	57	26	20	27	14	12
Average length of merchantable ears..................	in. 7·57	in. 5·55	in. 8·13	in. 6·64	in. 7·10	in. 7·55
Average weight of merchantable ears per 100 plants....	lbs. 48·5	lbs. 27·9	lbs. 46·6	lbs. 51·6	lbs. 46·8	lbs. 53·5
Average weight 100 merchantable ears.................	43·4	38·0	38·5	45·8	43·7	45·5

Average of both plats:

	Seed Used. Butt.	Central.	Tip kernels.
Merchantable ears per 100 plants............	111	90	118
Unmerchantable ears per 100 plants..........	42	20	16
Total ears per 100 plants....................	153	110	134
Average length of merchantable ears........	in. 7·1	in. 6·3	in. 7·8
Average weight merchantable ears per 100 plants	lbs. 50·0	lbs. 37·3	lbs. 50·0
Average weight of 100 merchantable ears. ...	44·6	40·9	42·0

The surprising as unexpected outcome of this experiment, hence can be formulated as follows:

1. The tip kernels were the most prolific of good corn.
2. The butt kernels were more prolific of good corn than the central kernels.
3. The tip kernels bore longer ears than the other kernels, the butt kernels the next, and the central kernels the shortest. This fact was apparent to the sight as the corn lay upon the ground after husking.
4. The merchantable ears from the butt were distinctly heavier than those from the tip, and those from the tip distinctly heavier than those from the central kernels.
5. The butt kernels furnished more unmerchantable corn than did the central kernels, and the central kernels more than did the tip kernels.

In order to give more prominence to the meaning of these figures, we calculate the yield per acre, allowing 75 pounds of ear-corn to the bushel of shelled corn; a method of presenting results which is fallacious if assumed to mean real yield per acre, but convenient and allowable if understood to represent calculated results only.

The figures upon which the results are calculated are as follows:

Each plant occupies 504 square inches of space; an acre contains 6,272,640 square inches, therefore an acre would contain 12,445 plants.

	Shelled corn per acre.
The 80 butt kernels yielded merchantable corn at rate of..	83 bush.
The 611 central " " " "	62 bush.
The 80 tip " " " "	83 bush.

Re-calculating for the manured and unmanured plats, we have:

	Unmanured per acre.	Manured per acre.
The butt kernels yielded merchantable corn at rate of.	79 bush.	85 bush.
The central kernels yielded merchantable corn at rate of..............................	46 bush.	78 bush.
The tip kernels yielded merchantable corn at rate of.	77 bush.	88 bush.
The total 426 kernels yielded merchantable corn at rate of.........................	68 bush.	....
The total 345 kernels yielded merchantable corn at rate of..........................	......	83 bush.

We may be pardoned if we call attention to the conditions which serve to add trustworthiness to the conclusions which these figures suggest, always desiring it to be noted, however, that the experimental researches of one season must be followed by the test or verification in the succeeding season before they should be accepted as finalities.

1. The seed used was of the Waushakum variety, a kind of corn which has now been bred for a number of years with the utmost care, until at present there is a good uniformity of quality in the product of its seed under given conditions, and a strong race character which gives it considerable power to resist individual variation.
2. The seed used was all from one ear, thus in connection with the

care that has been exercised for years past to guard against hybridization, insuring a seed corn of as uniform a character as can at present be obtained.

3. Both plats showed a remarkable uniformity of appearance as between their several rows, thus indicating uniformity of character in the soil upon which the seed was planted.

4. There was no difference apparent in the maturity of the various plants.

5. The ears were husked by ourselves and each plant's product laid by itself upon the ground at the foot of the stalk which bore the crop, thus insuring against mistake in the counting, measuring and weighing.

6. Three separate observers carefully went over each row and verified each other's conclusions, and thus absolute agreement in observations was secured on the spot.

As a matter of interest we present a table of the results for the eight rows, calculated to the 100 plants, in order that the variations under these favorable conditions of seed and soil may become prominent, and thus indicate in a measure the character of the seed and soil.

Row.		Unmanured. pounds.	Manured. pounds.
1.	Yield of merchantable ear corn per 100 plants,	41	46
2.	" " "	35	42
3.	" " "	35	48
4.	" " "	36	43
5.	" " "	40	42
6.	" " "	38	42
7.	" " "	38	41
8.	" " "	41	46

If we should calculate these rows to the acre the result would be a variation of about 10 bushels of 75 pounds for the unmanured rows, and 11 bushels for the manured rows per calculated acre, or but 14 1-3 and 13 1-4 per cent.

As a corollary to this presentation it will be observed that the 400 pounds of fertilizer used added but at the rate of 15 bushels of merchantable crop, while the use of tip kernels added at the rate of 31 bushels to the unmanured, and 11 bushels to the manured crop. It will also be observed that the outer rows of each plat are superior to the inner rows, but that this superiority does not hold with the second rows.

Intervals for Planting.

The plats of Waushakum corn, designed to test the influence of close or wide intervals, much or little seed per hill, etc., in planting, at harvest offered the following figures, calculated per acre, allowing 80 pounds ear-corn to the bushel of shelled corn:

Drill Planting.

	Drills.	No. of kernels per ft. of drill.	Yield, bushels. Good.	Poor.	Total.
4 B. Waushakum corn.....	44 in.	1	51·5	1·6	53·1
4 B'.1 Waushakum corn...	44 in.	4	14·1	14·9	29·0

Hill Planting.

	Hills.	Fertilizer per acre.	Yield, bushels. Good.	Poor.	Total.
5 A. Waushakum corn.....	1x1 ft.	400 lbs.	5.8	11.0	16.8
5 A. Waushakum corn.....	2x2 ft.	400 lbs.	7.0	11.6	18.6
5 B1. Waushakum corn....	3x3 ft.	400 lbs.	48.7	12.8	61.5
5 B1. Waushakum corn....	4x4 ft.	400 lbs.	35.9	2.5	38.4
6 A. Waushakum corn.....	5x5 ft.	400 lbs.	19.0	2.9	21.9
1 A 3. Waushakum corn....	3 1-2x3 2-3 ft.	400 lbs.	49.7	1.5	51.2
C 3. Waushakum corn	3x2 ft.	800 lbs.	39.1	9.8	48.9
C 5. Waushakum corn	3x3 1-2 ft.	1600 lbs.	62.2	3.3	65.5

Arranging these figures under the number of seed planted per acre, taking only those plats which received the same amount of fertilizer, we have for a table:

	Kernels per acre.	Yield, bushels. Good.	Poor.	Total.
6 A.	6,969	19·0	2·9	21·9
5 B..................	10,890	35·9	2·5	38·4
4 B..................	11,880	51·5	1·6	53·1
1 A 3................	13,577	49·7	1·5	51·2
5 B..................	19,360	48·7	12·8	61·5
5 A..................	43,560	5·8	11·0	16·8
5 A..................	43,560	7·0	11·6	18·6
4 B..................	47,520	14·1	14·9	29·0

More fertilizer being used:

	Kernels per acre.	Yield, bushels. Good.	Poor.	Total.
C 3..................	19,360	39·1	9·8	48·9
C 5..................	16,594	62·2	3·3	65·5

The closeness of planting that seems advisable, perhaps differs with locality. In Massachusetts, where the annual rain-fall was 45 inches, and the application of fertilizer was large, my customary seeding was intended to be 29,869 kernels per acre, and the average crop was about 80 bushels of shelled corn, with a maximum of 123 bushels of shelled corn. In a dry season my planting seemed at times too close. The difference of a few inches of rain-fall would necessitate, it seems to me, wider spaces, as the corn crop evaporates much water during growth, and if the plants exceed in their demand for water more than the soil can supply, injury to the crop seems the result. From the observation of one year, I am disposed to believe, that, as close planting cannot with advantage be practiced in Western New York as in Eastern Massachusetts; but the exceptional coolness of this past summer perhaps destroys the value of these experiments for the purpose of generalizing for a season of more favorable temperatures. It is also perhaps possible that the closeness of planting should vary with

different varieties of corn that have somewhat similar amounts of foliage; that it should vary as between small and large growing plants is self-evident. It seems quite probable that, in order to obtain maxima results, we must have abundant fertility and as close planting as the water supply for the locality, during the season of growth, will allow.

Depth of Planting.

What is the best depth to plant corn? As our facilities at the time of planting did not admit of a close *investigation* of this question, we made a simple trial in the field of various depths of planting in order to note results. The plants were in hills 42x44 inches apart, six kernels planted in a hill. We thus had nineteen hills planted, or one hundred and fourteen kernels at each depth. Thinned afterward to four stalks in a hill, but we omitted to note the amount of thinnings. The facts observed receive illustration in the following table:

	Row 1.	Row 2.	Row 3.	Row 4.	Row 5.
Depth planted	1-4 in.	1 in.	2 in.	3 in.	4 in.
Date planted	June 2	June 2	June 2	June 2	June 2
Date vegetated	June 12	June 12	June 13	June 16	June 16
Number of hills grew	19	19	19	19	19
Number of kernels grew after thinning to 4, *i. e.* furnished crop	76	76	68	61	76
Ear-corn yielded	23 lbs.	20 1-4 lbs.	17 1-2 lbs.	17 1-4 lbs.	19 1-2 lbs.
Ear-corn calculated to 100 stalks	30.6 lbs.	26.6 lbs.	25.7 lbs.	28.2 lbs.	25.4 lbs.

	Row 6.	Row 7.	Row 8.	Row 9.
Depth planted	5 in.	6 in.	7 in.	8 in.
Date planted	June 2	June 2	June 2	June 2
Date vegetated	June 16	June 16	June 16	June 16
Number of hills grew	19	16	15	17
Number of kernels grew after thinning to 4, *i. e.* furnished crop	66	59	48	50
Ear-corn yielded	18 lbs.	16 1-4 lbs.	14 1.4 lbs.	16 1-4 lbs.
Ear-corn calculated to 100 stalks	27.2 lbs.	27.5 lbs.	29.7 lbs.	32.5 lbs.

If we call one-fourth, one and two inch ordinary planting, three, four and five inch deep planting, and six, seven and eight inch very deep planting, we can form a table as follows:

	Ordinary planting.	Deep planting.	Very deep planting.
Actual yield...	60 3-4 lbs.	54 3-4 lbs.	46 3-4 lbs.
Actual yield calculated to bush. of 70 lbs. ear-corn per acre....................	52·0 bush.	46·9 bush.	40·0 bush.
Calculated yield per 100 stalks	27·6 lbs.	26·9 lbs.	29·1 lbs.
Calculated yield per 100 stalks re-calculated to acre figures.	53·9 bush.	52·5 bush.	56·8 bush.

The figures of this trial seem to indicate that deep planting caused loss of seed vegetating, but was followed by no evil effect upon the productiveness of the stalks that grew.

The wet season was perhaps the cause of the very shallow planting doing so well. A surprising observation was that the plantings from three to eight inches all vegetated alike on the same day. Deep planting caused the corn plant to stand no firmer in the soil than was the case with the shallow planted.

CULTIVATION EXPERIMENTS.

Yield calculated to acre. Eighty pounds ear-corn to one bushel shelled corn. Bowker's hill and drill phosphate used in the quantities noted.

	Waushakum Corn. Plat 1 A. Cultivated. Yield in bushels.			Willow Brook Corn. Plat 2 A. Cultivated. Yield in bushels.		
	Good.	Poor.	Total.	Good.	Poor.	Total.
No fertilizer	49·9	·8	50·7	48·6	2·2	50·8
200 pounds fertilizer	45·0	2·4	47·4	33·9	6·7	40·6
400 pounds fertilizer	49·7	1·5	51·2	52·7	2·3	55·0
800 pounds fertilizer	56·9	·7	57·6	47·9	2·4	50·3
1,600 pounds fertilizer	56·7	1·0	57·7	47·5	3·7	51·2
	51·6	1·2	52·9	46·1	3·4	49·5
	Uncultivated.			Uncultivated.		
	Good.	Poor.	Total.	Good.	Poor.	Total.
No fertilizer	54·7	·8	55·5	38·6	6·5	45·1
200 pounds fertilizer	53·8	3·5	57·3	47·3	3·9	51·2
400 pounds fertilizer	55·5	2·9	58·4	48·7	3·6	52·3
800 pounds fertilizer	58·5	1·2	59·7	48·7	4·3	53·0
1,600 pounds fertilizer	57·7	·7	58·4	50·7	2·2	52·9
	56·0	1·8	57·8	46·8	4·1	50·9

	Elmira Corn. Plat 1 B. Cultivated.			Waushakum Corn. Plat 2 B. Cultivated.		
	Good.	Poor.	Total.	Good.	Poor.	Total.
No fertilizer	51·9	1·4	53·3	52·0	1·2	53·2
200 pounds fertilizer	53·2	1·0	54·2	51·8	1·4	53·2
400 pounds fertilizer	58·3	·6	58·9	51·6	1·6	53·2
800 pounds fertilizer	51·9	·9	52·8	56·1	·4	56·5
1,600 pounds fertilizer	63.7	·6	64·3	55·3	·7	56·0
	55·8	·9	56·7	53·3	1·0	54·4
	Uncultivated.			Uncultivated.		
	Good.	Poor.	Total.	Good.	Poor.	Total.
No fertilizer	34·4	3·4	37·8	45·2	1·0	46·2
200 pounds fertilizer	26·4	3·9	30·3	40·6	1·9	42·5
400 pounds fertilizer	27·7	3·3	31·0	44·0	1·5	45·5
800 pounds fertilizer	58·4	1·0	59·4	49·4	·7	50·1
1,600 pounds fertilizer	59·7	·7	60·4	55·3	·2	55·5
	41·3	2·4	43·7	46·9	1·0	47·9

In series A we have apparent evidence against the usefulness of cultivation. In series B, in favor of cultivation. A kind of contradiction to which plat experiments are subject, and which throws doubts on results obtained by this method. We recapitulate:

	Yield calculated per acre.					
	Cultivated.			Uncultivated.		
	Good.	Poor.	Total.	Good.	Poor.	Total.
1 A Waushakum corn	51·6	1·2	52·9	56·0	1·8	57·8
2 A Willow Brook corn. . . .	46·1	3·4	49·5	46·8	4·1	50·9
Mean for the two	38·8	2·3	51·2	51·4	2·9	54·3
1 B Elmira corn.	55·8	·9	56·7	41·3	2·4	43·7
2 B Waushakum corn	53·3	1·0	54·4	46·9	1·0	47·9
Mean for the two	54·5	·9	55·5	44·1	1·7	45·8

It will be perceived that series A shows a loss of 2·6 bushels of merchantable, or 3·1 bushels total corn upon the cultivated portion. Series B shows a gain of 10·4 bushels merchantable, or 9·7 bushels total corn upon the cultivated portion. The Waushakum seed gave 4·4 bushels merchantable, or 4·9 bushels total corn less on the cultivated portion of series A, and 6·4 bushels merchantable, or 6·5 bushels total corn more on the cultivated portion of series B. The figures show, however, in three cases a diminution of poor corn upon the cultivated portion, and neither gain or loss in the fourth case. Of the twenty separate plats the cultivated ones showed less poor corn in thirteen cases, more in six cases and the same as the uncultivated in one case.

Root Pruning.

In experimenting with corn cultivation we made two trials of root pruning, using a spade, as the plants were coming to bloom, and destroying the roots by spading the intervals, six or eight inches deep, close to the plants. Such was the severity of the process, that the corn plants of these plats wilted at once, and did not recover their upright growth for a week or ten days, and during the balance of the season appeared yellow and in poor condition. The drawback of this trial was the clayey condition of the soil, which caused the earth to fall back after the spade in a lumpy condition, and we were unable to get the soil into that friable condition which would be considered as favorable to the extension of the amputated roots. The first plat tried was under a full application of fertilizer and a close planting. The second plat was one which was a duplicate of an excessively manured plat, yard dung being applied at the rate of 23 cords per acre, and fertilizer at the rate of 1,000 pounds per acre. The harvest figures are as follows:

Yield in Bushels.

		Merch. Ears.	Unmerch. Ears.	Total.
2	C 1. Excessively manured, not root pruned.	40.8	10.9	51.7
	C 2. Excessively manured, excessively pruned. . .	42.5	9.7	52.2

	Fertilizer.	Hills.				
1	C 3.	800 lbs.	3x3, not root pruned	39.1	9.8	48.9
	C 4.	800 lbs.	3x2, root pruned	23.2	20.0	43.2

These trials cannot be considered as possessing much value. The results are not only contradictory, but the total yield is too small. Unfortunately a heavy clay came to the surface in this region of our field, and as a consequence, while B 1, an unmanured plat adjoining, of inferior seed, yielded 49.3 bushels of merchantable, and 2.8 bushels of unmerchantable corn; 52.1 bushels total yield, the heavily manured plat yielded but 46.6 bushels of merchantable, and 12.1 bushels of unmerchantable; or a total of 58.8 bushels of corn. Even this heavy manuring was unable to overcome the physical incapacity of the soil, as is evidenced by the crop, as was also evidenced to the sight during the whole period of growth. Plat C 11 suffered less severely from the clay irruption, and consequently the two bushels gained, which might be ascribed by some to the cultivation, has but little significance. C 4, yielding so much small corn, gives testimony against the value of excessive root pruning in a soil which breaks in lumps rather than becomes friable under cultivation.

CORN HYBRIDIZATION.

The subject of hybridization in plants is one that is by no means clear. In the corn plant it is a universal belief among farmers, in which I have myself shared, that the influence of growing varieties together is to be seen in the hybridized kernels on the ears of the same year's yield. We have as yet no Station data whereby this belief can be verified. The Waushakum corn, the only variety whose history we know, is a pure corn, a pedigree corn, and has the confirmed habit of running true to its seed. In growing this variety along with many others, while we must believe that hybridization has been effected, yet we have been unable to find one single clear case of its presence being manifest in the kernels of the ears. On the other hand, other varieties of seed corn, varieties of whose purity we know nothing save the appearance of the kernels planted, have given us many examples of hybridization. Thus, for one instance, that peculiar variety, variously known as husk corn, pod corn, wild corn, Paraguay corn, etc., has furnished ears without any husk to the kernels, other ears containing kernels but slightly husked, other ears containing both husked and bare kernels, and the kernels themselves varying in their character from sweet corn, through the dents, to occasionally an apparent flint corn. The planting next year of the apparently unaffected Waushakum corn, as well as the use of the hybridized kernels of similar kinds for seed, will undoubtedly indicate to us the result of this year's hybridization, if any. We may, however, believe, subject to final proof, that there is a little stability of character in the varieties of corn as generally used; all more or less sharing the results of hybridization, except as kept in check through continuous selection.

The influence of hybridization on corn seed has been quite marked in a number of other instances. A fine appearing sample of white pop-corn, labeled "Egyptian pop," produced at harvest seven varieties which could well receive, if sorted out, distinct names as being differ-

ent varieties. The variations gave four distinct colors, or perhaps six if we count well-marked shades of color; two distinct shapes of ear and cob, and five distinct kinds of kernel. A sample of fine appearing, uniform kerneled white rice pop-corn yielded nine varieties sufficiently distinct to be described. These variations include ears of three distinct types, five distinct colors, or counting well-defined shades, nine colors, and kernels of four distinct shapes, from a round to a beaked form. Several ears had lost all appearance of a pop-corn, and resembled in size and shape an ordinary flint corn. One sample of Minnesota Dent corn, received from Milton B. Jarvis, of Canastota, N. Y., and which, as he wrote, may be tinctured with Dutton," but the ear sent, as well as the kernels used as seed, resembling the pure Dent variety received from Minnesota, when husked, October 12th, yielded a flinty corn, the Dent character having largely disappeared.

Corn Experiment — Varieties.

The figures of the yield of the several varieties of corn grown under equivalent intentions, as calculated to the acre, allowing 80 pounds ear-corn to the bushel, read

	Good.	Poor.	Total.
C 6. Blount's Prolific	0.0	74.7	74.7
C 7. Early Dent	0.0	49.0	49.0
C 8. Sibley's Pride of the North	27.8	2.8	30.6
C 9. Chester County Mammoth	35.0	8.5	43.5
C 10. Improved King Philip	44.3	2.1	46.4
C 13. White Flint	49.8	.8	50.6
D 2. Minnesota Dent (Minn. seed)	59.5	2.6	62.1
D 3. Minnesota Dent (seed grown in N. Y.)	49.5	2.0	51.5

Stolen Crops.

For the purpose of investigating into the influence of stolen crops upon the main crop, we selected three plats, and planted each with seed of the same White Flint corn, and subjected the plats to the same treatment. The cut-worm, however, nearly destroyed the beans in one plat, evidently preferring the bean to the corn, as the corn did not suffer. The yields were as below, calculating the twentieth acre plats to an acre:

Yield.

	Pumpkins.	Beans.	Corn. Good.	Corn. Poor.	Corn. Total.
	lbs.	lbs.	bush.	bush.	bush.
C 12. White Flint corn and beans	....	33	52.2	.7	52.9
C 13. White Flint corn	....	..	49.8	.9	50.7
C 14. White Flint corn and pumpkins	2380	..	46.0	1.6	47.6

Potato.

Our potato experiments have yielded a large crop of information. Planted under an elaborate scheme designed for the purpose of estimating by the tubers yielded the value of methods of planting, we have

to report failure and success : failure in securing the data anticipated and a success in discovering unexpectedly an important factor which seems to enter into the growing of the potato under diverse circumstances of soil, climate and culture. In giving our results to the public, we adopt two systems : the one the reporting of the experiments designed, and the yield ; the other, the lessons derived from our studies into the conditions which affect the plant and its yield. It will be perceived that our experiments proper were a failure, as neither was a satisfactory crop harvested in any case, nor are we able to explain fully the contradictions which are involved in our figures. The lessons we think we have derived through our study into the plant and its conditions under growth seem on the other hand pregnant with consequences, and need scarcely await the result of another year's verification to be given out as a discovery for guidance in practical farming.

The field selected for our potato crop in the early spring seemed adapted to our purpose. The lay of the land was favorable. In the wet and soggy condition of the whole farm, we recognized no especial indication of this field being either better or worse than any other that we might select. It was therefore ploughed and harrowed in the intervals between the rains, and as the condition of the soil would admit. A line drawn east and west divided the field into two portions ; the south portion receiving a fair dressing of barn-yard manure. As the land was worked it became evident that the northern portion was somewhat less clayey than the southern portion, and was slightly preferable for use. As the season advanced this difference in physical constitution became more marked. On April 18th, we commenced our planting in rows one hundred feet long four feet apart, using five varieties of potatoes, one hundred hills in a row, each hill receiving two seed. In designating the seed used, single eyes mean eyes chipped from the tuber by using the point of a knife and cutting a cone about one-quarter to one-half an inch deep, and the base containing the eye, about half an inch more or less in diameter. Ordinary cuts designate the potato cut lengthwise into halves, or into quarters according to the size of the tuber used.

A great loss of plant occurred in the case of the small eyes used as seed, and a quite wide discrepancy in time of vegetation occurred in all the rows. The figures of the crop are given below, the vegetation line meaning the number of plants counted at the various dates ; the yield recorded as nothing when not of sufficient value to be even classed as unmerchantable.

Single eyes, cut close ; level culture ; three inches deep ; unmanured; 100 hills ; planted April 18.

	Row 1. Early Ohio.	Row 3. Early Rose	Row 5. Snow-flake.	Row 7. Bur-bank's.	Row 9. Beauty of Hebron.
Vegetated May 22,	0	0	0	0	3 hills.
Vegetated May 24,	0	0	0	0	11 hills.
Vegetated May 26,	0	0	0	0	19 hills.
Vegetated May 29,	0	0	5 hills.	0	40 hills.
Vegetated May 31,	2 hills.	7 hills.	34 hills.	33 hills.	72 hills.
Vegetated June 5,	11 hills.	34 hills.	75 hills.	64 hills.	88 hills.
Bloom recorded,	None.	None.	None.	None.	None.
Yield merch. tubers,	0	1 1-4 lbs.	0 lb.	5 lbs.	5 1-2 lbs.
Yield unmerch. tubers,	1-2 lb.	2 1-2 lbs.	4 lbs.	4 lbs.	14 3-4 lbs.

Single eyes, cut close ; level culture ; six inches deep ; unmanured ; 100 hills ; planted April 19.

	Row 11. Early Ohio.	Row 13. Early Rose.	Row 15. Snow-flake.	Row 17. Bur-bank's	Row 19 Beauty of Hebron.
Vegetated May 22,	0	0	0	0	0
Vegetated May 31,	0	2 hills.	0	0	6 hills.
Vegetated June 1,	0	8 hills.	7 hills.	0	6 hills.
Vegetated June 5,	0	26 hills.	80 hills.	22 hills.	21 hills.
Bloom recorded,	None.	None.	None.	None.	None.
Yield, merch. tubers,	0	12 1-4 lbs.	1 1-2 lbs.	9 lbs.	2 3-4 lbs.
Yield, unmerch. tubers,	1 1-2 lbs.	6 1-2 lbs.	5 3-4 lbs.	7 lbs.	7 1-4 lbs.

Single eyes, cut close ; ridge culture ; three inches deep ; unmanured ; 100 hills ; planted April 24.

	Row 41. Early Ohio.	Row 43. Early Rose.	Row 45. Snowflake.	Row 47. Burbank's.	Row 49. Beauty of Hebron.
Vegetated May 28,	0	1 hill.	0	0	0
Vegetated May 29,	0	8 hills.	0	1 hill.	1 hill.
Vegetated May 30,	9 hills.	8 hills.	3 hills.	2 hills.	1 hills.
Vegetated June 5,	36 hills.	33 hills.	30 hills.	13 hills.	18 hills.
Bloom recorded,	None.	None.	None.	None.	None.
Yield, merch. tubers,	1 lbs.	0	0	1-2 lb.	1 1-4 lbs.
Yield, unmerch. tubers,	4 3-4 lbs.	2 1-2 lbs.	1 1-4 lbs.	1 3-4 lbs.	3 3-4 lbs.

Single eyes, cut close ; ridge culture ; six inches deep ; unmanured ; 100 hills ; planted April 25.

	Row 51. Early Ohio.	Row 53. Early Rose.	Row 55. Snowflake.	Row 57. Burbank's.	Row 59. Beauty of Hebron.
Vegetated May 30,	0	0	0	0	1 hill.
Vegetated June 5,	2 hills.	0	4 hills.	2 hills.	7 hills.
Bloom recorded,	None.	None.	None.	None.	None.
Yield, merch. tubers,	3-4 lb.	0	0	1-4 lb.	0
Yield, unmerch. tubers,	1 3-4 lbs.	1 1-2 lbs.	1 1-2 lbs.	1 1-4 lbs.	1 1-2 lbs.

Single eyes, cut close; level culture ; unmanured ; 100 hills ; planted April 26.

Two inches deep.

	Row 81. Early Rose.	Row 82. Snowflake.	Row 83. Beauty of Hebron.	Row 84. Beauty of Hebron.
Vegetated June 1,	5 hills.	0	0	0
Vegetated June 5,	12 hills.	3 hills.	1 hill.	2 hills.
Bloom recorded,	None.	None.	None.	None.
Yield, merch. tubers,	0	0	3-4 lb.	0
Yield, unmerch. tubers,	0	0	1 3-4 lbs.	0

Four inches deep.

	Row 85. Early Rose.	Row 86. Snowflake.	Row 87. Beauty of Hebron.	Row 88. Beauty of Hebron.
Vegetated June 5,	1 hill.	0	0	0
Bloom recorded,	None.	None.	None.	None.
Yield, merch. tubers,	3-4 lb.	0	3-4 lb.	1-2 lb.
Yield, unmerch. tubers,	1-4 lb.	0	1 3-4 lbs.	1-4 lb.

Six inches deep.

	Row 89. Early Rose.	Row 90. Snowflake.	Row 91. Beauty of Hebron.	Row 92 (97 h.). Beauty of Hebron.
Vegetated June 5,	0	0	0	2 hills.
Bloom recorded,	None.	None.	None.	None.
Yield, merch. tubers,	0	0	2 1-2 lbs.	1 1-4 lbs.
Yield, unmerch. tubers,	0	0	1 1-4 lbs.	1-4 lb.

Eight inches deep.

	Row 93 (89 hills). Early Rose.	Row 94 (74 hills). Snowflake.	Row 95 (78 hills). Burbank's.	Row 96 (82 hills). Beauty of Hebron.
Vegetated June 5,	0	0	0	0
Yield, merchantable tubers,	0	1-2 lb.	1-4 lb.	0
Yield, unmerchantable tubers,	0	1-2 lb.	1-4 lb.	0

Single eyes, cut deep; level culture; four inches deep; planted April 26.

	188 hills. Early Rose.	115 hills. Snowflake.	139 hills. Burbank's.	112 hills. Beauty of Hebron.
Vegetated May 22,	0	0	0	2 hills.
Vegetated May 24,	0	0	0	20 hills.
Vegetated May 25,	3 hills.	0	0	20 hills.
Vegetated May 29,	20 hills.	33 hills.	21 hills.	74 hills.
Vegetated June 1,	53 hills.	71 hills.	63 hills.	88 hills.
Bloom recorded,	July 3.	None.	July 14.	June 29.
Yield, merchantable tubers,	47 1-2 lbs.	35 3-4 lbs.	82 3-4 lbs.	61 lbs.
Yield, unmerchantable tubers,	14 3-4 lbs.	11 3-4 lbs.	12 1-2 lbs.	17 3-4 lbs.

Upon the manured portion we note the following results:

Single eyes, cut close; level culture; three inches deep; manured; 100 hills; planted April 22.

	Row 21. Early Ohio.	Row 23. Early Rose.	Row 25. Snowflake.	Row 27. Burbank's.	Row 29. Be'ty of Hebron.
Vegetated May 29,	0	1 hill.	4 hills.	4 hills.	2 hills.
Vegetated June 1,	16 hills.	18 hills.	26 hills.	20 hills.	6 hills.
Vegetated June 5,	19 hills.	55 hills.	65 hills.	52 hills.	29 hills.
Bloom recorded,	None.	None.	None.	None	None.
Yield, merch. tubers,	0	7 1-2 lbs.	0	7 lbs.	1 lb.
Yield, unmerch. tubers,	1 1-4 lbs.	10 1-4 lbs.	7 3-4 lbs.	9 3-4 lbs.	4 1-2 lbs.

Single eyes, cut close; level culture; six inches deep; manured; 100 hills planted.

	Row 31. Early Ohio.	Row 33. Early Rose.	Row 35. Snowflake.	Row. 37. Burbank's.	Row 39. Be'ty of Hebron.
Planted,	April 22.	April 22.	April 24.	April 24.	April 24.
Vegetated May 29,	71 hills.	0	0	0	0
Vegetated June 1,	0	1 hill.	0	0	0
Vegetated June 5,	0	2 hills.	0	0	0
Bloom recorded,	None.	July 6.	None.	None.	None.
Yield, merch. tubers,	0	2 3-4 lbs.	0	0	0
Yield, unmerch. tubers,	0	5 1-4 lbs.	0	0	0

Single eyes, cut close; ridge culture; 3 inches deep; manured; 100 hills; planted April 25.

	Row 61. Early Ohio.	Row 63. Early Rose.	Row 65. Snowflake.	Row 67. Burbank's.	Row 69. Beauty of Hebron.
Vegetated June 1,	0	1	0	0	1 hill.
Vegetated June 5,	7	15	6	2 hills.	5 hills.
Bloom recorded,	None.	None.	None.	None.	None.
Yield, merch. tubers,	1-2 lb.	0	0	1-2 lb.	1 1-4 lbs.
Yield, unmerch. tubers,	2 lbs.	0	1-2 lb.	1 1-4 lbs.	5 3-4 lbs.

Single eyes, cut close; ridge culture; 6 inches deep; manured; 100 hills.

	Row 71. Burbank's.	Row 73. Early Rose.	Row 75. Snowflake.	Row 77. Burbank's.	Row 79. Beauty of Hebron.
Planted,	April 25	April 25	April 25.	April 26	April 26
Vegetated,	0	1 hill.	2 hills.	4 hills.	1 hill.
Bloom recorded,	None.	None.	None.	None.	None.
Yield, merch. tubers,	0	0	0	0	0
Yield, unmerch. tubers,	1 1-2 lbs.	1 1-4 lbs.	0	1 1-2 lbs.	0

Ordinary cuts; level culture; 3 inches deep; unmanured; 100 hills; planted April 18.

	Row 2. Early Ohio.	Row 4. Early Rose.	Row 6. Snowflake.	Row 8. Burbank's.	Row 10. Beauty of Hebron.
Vegetated May 19,	0	0	1 hill.	1 hill.	4 hills.
Vegetated May 20,	1 hill.	1 hill.	1 hill.	1 hill.	4 hills.
Vegetated May 24,	41 hills.	68 hills.	61 hills.	68 hills.	77 hills.
Vegetated May 26,	84 hills.	91 hills.	82 hills.	85 hills.	96 hills.
Vegetated May 30,	100 hills.	99 hills.	99 hills.	99 hills.	100 hills.
Bloom recorded,	None.	July 8	None.	June 29	July 3
Yield, merch. tubers,	47 1-4 lbs.	97 1-4 lbs.	34 1-2 lbs.	107 lbs.	35 lbs.
Yield, unmerch. tubers,	40 1-2 lbs.	65 lbs.	59 1-2 lbs.	84 1-4 lbs.	63 lbs.

Ordinary cuts; level culture; 6 inches deep; unmanured; 100 hills; April 19.

	Row 12. Early Ohio.	Row 14. Early Rose.	Row 16. Snowflake.	Row 18. Burbank's	Row 20. Beauty of Hebron.
Vegetated May 22,	0	8 hills.	0	1 hill.	1 hill.
Vegetated May 26,	0	51 hills.	21 hills.	12 hills.	29 hills.
Vegetated May 29,	9 hills.	88 hills.	80 hills.	54 hills.	74 hills.
Vegetated June 1,	80 hills.	98 hills.	97 hills.	98 hills.	88 hills.
Bloom recorded,	None.	July 8	None.	June 29	June 29
Yield, merch. tubers,	19 1-2 lbs.	80 1-4 lbs.	34 3-4 lbs.	91 1-2 lbs.	40 1-2 lbs.
Yield, unmerch. tubers,	36 3-4 lbs.	42 1-4 lbs.	50 1-4 lbs.	41 3-4 lbs.	50 3-4 lbs.

Ordinary cuts; level culture; unmanured; 100 hills; planted April 25.

	Row 111. 2 in. deep. Burbank's.	Row 112 2 in. deep. Beauty of Hebron.	Row 113. 4 in. deep.	Row 115. 6 in. deep. Snowflake.
Vegetated May 22,	0	8 hills.	0	0
Vegetated May 24,	0	12 hills.	3 hills.	0
Vegetated May 26,	0	28 hills.	9 hills.	0
Vegetated May 29,	12 hills.	62 hills.	37 hills.	11 hills.
Vegetated June 1,	51 hills.	89 hills.	84 hills.	57 hills.
Bloom recorded,	July 14.	July 3.	July 14.	July 14.
Yield, merch. tubers,	40 lbs.	29 lbs.	24 lbs.	25 3-4 lbs.
Yield, unmerch. tubers,	38 3-4 lbs.	32 3-4 lbs.	35 1-2 lbs.	30 1-4 lbs.

Ordinary cuts; level culture; unmanured; 100 hills; planted April 25.

	Row 117. 8 in. deep.	Row 114. 4 in. deep. Early Rose.	Row 116. 6 in. deep. Early Rose.
Vegetated May 22,	0	1 hill.	0
Vegetated May 24,	0	4 hills.	0
Vegetated May 26,	0	19 hills.	12 hills.
Vegetated May 29,	5 hills.	54 hills.	29 hills.
Vegetated June 1,	40 hills.	86 hills.	70 hills.
Bloom recorded,	None.	June 29.	June 29.
Yield, merch. tubers,	24 lbs.	24 3-4 lbs.	27 1-2 lbs.
Yield, unmerch. tubers,	31 3-4 lbs.	47 1-4 lbs.	39 lbs.

Ordinary cuts; ridge culture; 3 in. deep; unmanured; 100 hills; planted April 24.

	Row 42. Early Ohio.	Row 44. Early Rose.	Row 46. Snow flake.	Row 48. Burbank's	Row 50. Beauty of Hebron.
Vegetated May 22,	0	14 hills.	2 hills.	1 hill.	11 hills.
Vegetated May 23,	1 hill.	....	....	......	... ...
Vegetated May 26,	42 hills.	65 hills.	37 hills.	7 hills.	46 hills.
Vegetated June 1,	82 hills.	98 hills.	98 hills.	72 hills.	96 hills.
Bloom recorded,	June 29.	July 3	None.	July 3.	June 29.
Yield, merch. tubers,	46 1-4 lbs.	30 1-4 lbs.	21 1-4 lbs.	66 lbs.	42 lbs.
Yield, unmerch. tubers,	48 lbs.	61 lbs.	49 lbs.	40 lbs.	52 1-2 lbs.

Ordinary cuts; ridge culture; 6 in. deep; unmanured; 100 hills; planted April 25.

	Row 52. Early Ohio.	Row 54. Early Rose.	Row 56. Snowflake.	Row 58. Burbank's.	Row 60. Beauty of Hebron.
Vegetated May 22,	2 hills.	0	1 hill.	0	0
Vegetated May 26,	10 hills.	10 hills.	4 hills.	2 hills.	9 hills.
Vegetated June 1,	87 hills.	78 hills.	78 hills.	61 hills.	73 hills.
Bloom recorded,	June 29.	July 3.	None.	July 6.	June 29.
Yield, merch. tubers,	32 lbs.	11 1-2 lbs.	15 lbs.	63 3-4 lbs.	23 lbs.
Yield, unmerch. tubers,	39 1-4 lbs.	53 3-4 lbs.	42 lbs.	35 1-4 lbs.	42 lbs.

Ordinary cuts; level culture; three inches deep; manured; 100 hills; planted April 22.

	Row 22. Early Ohio.	Row 24. Early Rose.	Row 26. Sn'flake.	Row 28. Burbank's.	Row 30. Beauty of Hebron.
Vegetated May 22,	0	8 hills.	8 hills.	13 hills.	4 hills.
Vegetated May 25,	8 hills.	27 hills.	29 hills.	32 hills.	25 hills.
Vegetated June 1,	100 hills.	100 hills.	100 hills.	98 hills.	92 hills.
Bloom noted,	None.	June 29.	None.	June 29.	July 3.
Yield, merch. tubers,	22 lbs.	42 3-4 lbs.	23 lbs.	67 1-2 lbs.	21 lbs.
Yield, unmerch. tubers,	44 1-4 lbs.	53 3-4 lbs.	52 1-2 lbs.	48 lbs.	52 1-4 lbs.

Ordinary cuts; level culture; six inches deep; manured; 100 hills; planted April 24.

	Row 32. Early Ohio.	Row 34. Early Rose.	Row 36. Sn'flake.	Row 38. Burbank's.	Row 40. Beauty of Hebron.
Vegetated May 22,	1 hill.	0	0	0	0
Vegetated May 25,	15 hills.	0	0	0	1 hill.
Vegetated May 29,	59 hills.	18 hills.	10 hills.	3 hills.	47 hills.
Vegetated June 1,	93 hills.	52 hills.	63 hills.	26 hills.	89 hills.
Bloom noted,	June 29.	June 29.	None.	July 6.	June 29.
Yield, merch. tubers,	22 1-4 lbs.	18 lbs.	14 lbs.	51 1-4 lbs.	24 1-2 lbs.
Yield, unmerch. tubers,	39 lbs.	42 lbs.	38 1-2 lbs.	32 lbs.	35 1-2 lbs.

Ordinary cuts; ridge culture; three inches deep; manured; 100 hills; planted April 25.

	Row 62. Early Ohio.	Row 64. Early Rose.	Row 66. Sn'flake.	Row 68. Burbank's.	Row 70. Beauty of Hebron.
Vegetated May 22,	2 hills.	1 hill	0	1 hill.	0
Vegetated May 23,	....	....	....	....	1 hill.
Vegetated May 25,	7 hills.	11 hills.	1 hill.	....	....
Vegetated May 29,	34 hills.	56 hills.	18 hills.	3 hills.	29 hills.
Vegetated June 1,	76 hills.	90 hills.	62 hills.	87 hills.	88 hills.
Bloom recorded,	June 29.	June 29.	None.	July 14.	June 29.
Yield, merch. tubers,	26 1-4 lbs.	14 1-4 lbs.	15 1-4 lbs.	46 3-4 lbs.	24 3-4 lbs.
Yield, unmerch. tubers,	37 lbs.	41 1-2 lbs.	36 1-2 lbs.	28 1-4 lbs.	39 1-2 lbs.

Ordinary cuts; ridge culture; six inches deep; manured; 100 hills; planted April 25–26:

	Row 72. Burbank's.	Row 74. Early Rose.	Row 76. Snowflake.	Row 78. Burbank's.	Row 80. Bea'ty of Hebron
Vegetated May 25,	0	1 hill.	0	0	0
Vegetated May 29,	1 hill.	27 hills.	17 hills.	2 hills.	18 hills.
Vegetated June 1,	17 hills.	70 hills.	59 hills.	14 hills.	59 hills.
Bloom recorded,	July 14.	July 8.	None.	July 6.	June 29.
Yield, merch. tubers,	42 lbs.	9 3-4 lbs.	16 lbs.	41 1-4 lbs.	36 3-4 lbs.
Yield, unmerc. tubers,	32 1-4 lbs.	37 lbs.	30 1-4 lbs.	22 lbs.	32 lbs.

In order to better understand these figures we rearrange as below: Single eyes, cut close; yield of merchantable tubers per 100 hills.

Unmanured	Early Ohio.	Early Rose.	Snowflake.	Burbank's.	Beauty. of Hebron.
Level culture, 2 in. deep,	....	0	0	1 3-4 lbs.	0
Level culture, 3 in. deep,	0	1 1-4 lbs.	0	5 lbs.	5 1-2 lbs.
Level culture, 4 in. deep,	....	3-4 lbs.	0	3-4 lb.	1-2 lb.
Level culture, 6 in. deep,	0	12 1-4 lbs.	1 1-2 lbs.	9 lbs.	2 3-4 lbs.
Level culture, 8 in. deep,	....	0	1-2 lb.	1-4 lb.	0
Ridge culture, 3 in. deep,	1 lb.	0	0	1-2 lb.	1 1-4 lbs.
Manured.					
Level culture, 3 in. deep,	0	7 1-2 lbs.	0	7 lbs.	1 lb.
Level culture, 6 in. deep,	0	5 1-4 lbs.	0	0	0
Ridge culture, 3 in. deep,	1-2 lb.	0	0	1-2 lb.	1 1-4 lbs.
Ridge culture, 6 in. deep,	0	0	0	0	0

Single eyes, cut deep; yield of merchantable tubers:

	Early Ohio.	Early Rose.	Snowflake.	Burbank's.	Beauty. of Hebron.
Number of hills,	....	133.	115.	139.	112.
Level culture, 4 in. deep,	....	47 1-2 lbs.	35 3-4 lbs.	82 3-4 lbs.	61 lbs.
Calculat'd to the 100 hills,	....	35 3-4 lbs.	31 lbs.	59 1-2 lbs.	54 1-2 lbs.

Ordinary cuts; yield of merchantable tubers per 100 hills:

Unmanured.	Early Ohio.	Early Rose.	Snowflake.	Burbank's	Beauty of Hebron.
Level culture, 3 in. deep,	47 1-4 lbs.	87 1-4 lbs.	34 1-2 lbs.	107 lbs.	35 lbs.
Level culture, 6 in. deep,	19 1-2 lbs.	80 1-4 lbs.	50 1-4 lbs.	41 3-4 lbs.	50 3-4 lbs.
Ridge culture, 3 in. deep,	46 1-4 lbs.	30 1-4 lbs.	21 1-4 lbs.	66 lbs.	42 lbs.
Ridge culture, 6 in. deep,	32 lbs.	11 1-2 lbs.	15 lds.	63 3-4 lbs.	23 lbs.
Manured.					
Level culture, 3 in. deep,	22 lbs.	42 3-4 lbs.	23 lbs.	67 1-2 lbs.	21 lbs.
Level culture, 6 in. deep,	22 1-4 lbs.	18 lbs.	14 lbs.	51 1-4 lbs.	24 1-2 lbs.
Ridge culture, 3 in. deep,	26 1-4 lbs.	14 1-4 lbs.	15 1-4 lbs.	46 3-4 lbs.	24 3-4 lbs.
Ridge culture, 6 in. deep,	42 lbs.	9 3-4 lbs.	16 lbs.	41 1-4 lbs.	36 3-4 lbs.

We note a difference in yield as between varieties, and a difference in the power of the seed to overcome difficulties in vegetation. Under the unfavorable conditions of the soil of the field unfortunately selected, we obtained a full crop in but few instances. During growth we saw no indication of benefit derived from the manure applied, and our figures at harvest seem to indicate the truth of this observation. The influence of cutting the seed is also well marked in every case. Calculating the yields to the acre, in bushels of sixty pounds, we have the following figures to offer as an average of the various kinds of planting.

Three and six inches deep.	Early Ohio.	Early Rose.	Snow-flake.	Bur-bank's.	Beauty of Hebron.
Single eyes, cut close, manured	.4	5.8	....	3.4	1
Single eyes, cut close, unmanured	.4	5.8	.6	6.6	4.8
Four inches deep.					
Single eyes, cut deep, unmanured	....	64.9	56.2	108	99
Three and six inches deep.					
Ordinary cuts, manured	51	38.4	31	93.7	48.5
Ordinary cuts, unmanured	66.3	94.8	54.9	126.2	68.3

Yield per calculated acre in bushels.

This table offers important indications. Thus, we observe that the unmanured portion of the field in every case gave superior yield to the manured portion, and be it remembered a good dressing of farm yard dung was applied. Thus, average for the various plats.

	Manured.	Unmanured.
Single eyes, cut close	2·1 bush.	3·5 bush.
Ordinary cuts	52·5 bush.	82·1 bush.

We may assume, then, that the plat system with manure is incapable of giving just measurement in any one year of the efficacy of fertilizer ; in other words, manure under certain circumstances is unable to overcome at once slight physical differences between soils.

Our next observation is the difference between the producing power of varieties. Under equivalent circumstances of seed, excluding the shallow cut eyes, the order of productiveness stood as follows :

Burbank's yielded at the rate of	109·3 bush. per acre.
Beauty of Hebron yielded at the rate of	71·9 bush. per acre.
Early Rose yielded at the rate of	66·0 bush. per acre.
Snowflake yielded at the rate of	47·4 bush. per acre.

We note as proven, that under circumstances of field culture, where the character of the soil is unfavorable, the use of single eyes cut shallow, that is eyes containing but small portion of potato skin and substance, is not to be recommended. Our crop from this seeding was a failure both in respect to the number of seed which vegetated, and in the yield of those that vegetated. Single eyes cut so as to include the prolongation of the eye into the substance of the potato yielded an average of eighty-two bushels per acre, while ordinary half-potato seed produced eighty-six bushels per acre.

The figures obtained which bear upon the depth of planting may be selected from our tables and arranged as below :

	Early Ohio.	Early Rose.	Snowflake.
Ordinary cuts ; manured ; 3 inches deep,	43.7 bush.	51.6 bush.	34.6 bush.
Ordinary cuts ; unmanured ; 3 inches deep,	84.7 bush.	106.5 bush.	50.5 bush.
Ordinary cuts ; manured ; 5 inches deep,	58.2 bush.	25.1 bush.	27.2 bush.
Ordinary cuts ; unmanured ; 6 inches deep,	46.6 bush.	83.2 bush.	59.1 bush.
Average of 3 inch planting,	64.2 bush.	79.1 bush.	42.6 bush.
Average of 6 inch planting,	71.5 bush.	54.2 bush.	43.2 bush.

	Burbank's.	Beauty of Hebron.
Ordinary cuts ; manured ; 3 inches deep,	103.6 bush.	41.5 bush.
Ordinary cuts ; unmanured ; 3 inches deep,	156.8 bush.	68.9 bush.
Ordinary cuts ; manured ; 6 inches deep,	88.4 bush.	55.4 bush.
Oridnary cuts ; unmanured ; 6 inches deep,	95.6 bush.	66.9 bush.
Average of 3 inch planting,	130.2 bush.	55.2 bush.
Average of 6 inch planting,	72.0 bush.	61.2 bush.

That is, the three inch planting yielded on the average 74·2 bushels per acre, to the six inch planted 60·4 bushels per acre. With three varieties, however, the figures show in favor of the deep planting 4·6 bushels ; with two varieties in favor of shallow planting 41·5 bushels. per acre.

Level and ridge culture show figures as below :

	Early Ohio.	Early Rose.	Snowflake.
Ordinary cuts; level culture,	50.3 bush.	103.4 bush.	55.2 bush.
Ordinary cuts; ridge culture,	66.4 bush.	29.8 bush.	30.6 bush.

	Burbank's.	Beauty of Hebron.
Ordinary cuts ; level culture,	121.2 bush.	59.5 bush.
Ordinary cuts; ridge culture,	100.4 bush.	57.3 bush.

We here have 79·9 bushels for level culture, and 56·9 bushels for ridge culture, the ridge culture bringing the largest yield in one instance only. If we eliminate from these results the effect of deep and shallow planting we find but little certain difference to be ascribed to the ridging or not ridging. Thus, at three inches depth seven results out of ten are in favor of level culture ; at six inches depth five results out of ten are in favor of level culture.

In our experiments with distances of planting, the poor condition of the soil would be expected to render the results inconclusive. We, however, offer the figures as noted. The variety, Snowflake ; the fertilizer used, Bowker's hill and drill, 544 pounds per acre, broadcasted ; the size of plats, 20 feet square or 400 square feet ; the seed, single eyes, cut deep, one seed in a place ; planted May 19.

Yield.

	Unmanured.		Manured.	
	Merch. Tubers. lbs.	Small. Tubers. lbs.	Merch. Tubers. lbs.	Small. Tubers. lbs.
Hills six inches apart both ways.....	5 3-4	50	9	61 1-4
Hills one foot apart both ways.......	17 1-2	31 1-4	38 1-4	41 1-4
Hills eighteen inches apart both ways,	20	34 3-4	30	35 1-2
Hills two feet apart both ways.......	10 1-2	18	29 1-2	27 1-4

Multiplying our results by 108.9, in order to get acre figures in pounds, and dividing by 60 to obtain bushels, we have :

	Unmanured.		Manured.	
	Merch. Tubers. bush.	Small. Tubers. bush.	Merch. Tubers. bush.	Small. Tubers. bush.
Hills six inches apart both ways	10.4	90.7	16.3	111.1
Hills one foot apart both ways...........	15.1	56.7	69.4	74.9
Hills eighteen inches apart both ways	36.1	63.0	54.4	64.4
Hills two feet apart both ways...........	19.0	32.6	53.5	49.4

The indications of these figures seem to be that the thickness of seeding has a relation to the character of the soil. In rich soil thick seeding being more advantageous than in infertile soil. We also remark that the yield of small potatoes diminishes as the space of planting increases. The influence of the fertilizer applied seems very marked, counter to the case with the other plantings, the average yield of the unfertilized soil being 20 bushels per acre ; of the fertilized soil, 48 bushels ; or a difference of 28 bushels.

1. The potatoes planted in the garden were designed to be dug during growth for the purpose of studying into the underground processes. It would be confusing, and seems unnecessary to enter into a statement of the dates of planting and the full particulars noted at the various dates of examination. Suffice it to say that the variety used was the Early Rose. The system of planting included level culture, hill culture, ridge culture; single eyes cut small, and single eyes cut as large as possible: half potatoes, whole potatoes, seed ends, stem ends; potato shoots, potato peelings.

Some rows received ordinary cultivation, other rows excessive cultivation, and still other rows no cultivation at all. One plat was covered with straw, the seed being laid on the ground; another plat covered with four inches of sand, and another with six inches of sand, the seed being laid on the ground; another plat mulched in the intervals of high ridges, which received the seed; one potato plant hilled to the depth of four feet two inches, etc. In complementary trials potatoes from which the eyes had been deeply removed were planted; other potatoes which had been peeled; leaves slipped in the cold frame and then when rooted removed to the open ground; potatoes which had started into growth and then the growing shoots rubbed off; potatoes whose eyes were injured by scalding; potatoes from which the central portion had been removed; single eyes split into many pieces, etc. In addition, before the ground was fit for planting, potato eyes and whole potatoes were started into growth in glass vessels in the house, and the growth and development carefully measured and commented upon.

Among the first observations, which were yielded from the digging up the growing plants, were the great diversity in the tuber formation of adjoining hills. In one hill when small tubers were already formed, in an adjoining hill there would be no appearance of tuber; in one hill, perhaps, numerous tubers, in another hill but few; in one hill large, in another small tubers. With all this variation, which in part held true during the whole period of growth, there seemed absolutely no relation between the appearance of the green tops and the formation of tuber; large growth of top did not necessarily indicate abundance of tuber, nor did small growth of top indicate sparseness of tuber. In the recognition of these divergences, it seemed essential to seek for a cause by digging series of plants and observing whether there could be seen any common character which should be coincident with abundance or scarcity, earliness or lateness of yield.

In the grouping of the likenesses together, the whole plant being brought under study, we very soon noted that there was a relation between the character of the seed cutting and the yield. Acting upon this clue, we noted that single eyes produced larger yield and greater evenness of yield, together with superior quality over cuttings which included many eyes, and that while small cut eyes were inferior to large cut eyes in general, yet that the depth to which the cutting was made into the seed potato exerted a strong and undeniable influence on the crop. We now had a suggestion for further investigation, and it was pursued in this manner. Whole potatoes were sliced lengthwise so that the cut should bisect as many eyes as possible. These slices were then stained with a carmine solution. We thus were enabled to note that the potato tuber had a certain visible internal structure,

bundles of tissue forming appearances which may be likened to a central stem with branches extending to each eye, and to which the eye served as a terminal bud. Returning now to the garden we quickly noted that wherever the potato eye used as seed included the whole length of one of these internal branches, the yield was large and fair; where the cut shortened this branch, then the yield fell off. A further examination into growth of single eyes in common and highly enriched soil made evident that this observation gave the key to successful harvest on common soil, but that rich soil was able, in a measure, to offset the advantages gained. Thus, on common soil, while a potato eye cut shallow gave insignificant results, on very rich soil the eye could be divided and subdivided into many pieces and yet give large yield. Thus, for illustration, 100 hills with 200 small shallow eyes planted yielded but five pounds of merchantable tubers; 100 hills with 200 smallish eyes cut so as to include the branch structure yielded 59½ pounds. Field culture in these instances, and many hills failing to vegetate through the sun-hardened soil. The corresponding yield of ordinary cuttings was 40 pounds to the 100 hills of 200 seed. In very fertile soil, under garden culture, the same variety, the eyes divided into many pieces, started in the cold frame and transplanted into place, yielded 100 pounds of merchantable tubers to 100 hills of 100 plants. The record of yields of single eyes cut shallow and cut deeply was made at various intervals, and the following figures may be given.

June 23, single plants.

Yield from.	Weight of tuber. Grains.	Weight of root. Grains.	Weight of top. Grains.
Single eyes, cut shallow	54	13	410
Single eyes, cut deep	960	100	2,160
Whole potatoes	71	138	1,880

The single eyes, cut deep, yielded five tubers averaging 1⅛ inch in diameter, the largest 1⅝ inch in diameter.

July 3, single plants.

Yield from.	Number of stalks.	Number of tubers.	Weigt of tubers. Grains.
Number 1, single eyes, cut shallow	1	7	828
Number 2, single eyes, cut deep	3	5	2,871
Number 3, whole potatoes	10	16	3,104

Two hills were dug, the tops appearing similar, half potatoes used as seed, the seed attached and showing in No. 4 but one eye developed, and the plant a large one. An examination showed that this eye which had grown had been shortened by the cutting the potato in half. Three stalks formed the plant. No. 5 was the corresponding half of the seed of No. 4, two eyes had developed, and examination traced these eyes 1⅞ and 1¾ inch deep within the seed. The results of the examination in figures are as below:

	Number of tubers.	Weight of tubers Grains.	Tubers under 1 in. diam.	Tubers over 1 in. diam.	Largest tuber. Inches.
Number 4.........	6	741	3	3	1¼x1¾
Number 5.........	12	2,308	5	7	1¾x2¼

August 30 we dug ten hills of potatoes in row of the single eyes, cut shallow, and twenty hills in row of the single eyes, cut deep, twenty hills of ordinary cuts and twenty hills of whole potatoes used as seed. The results noted were as below, multiplying the first set by two in order to have comparable figures :

Seed Used.	No. merch. tubers.	No. unmerch. tubers.	Weight of merch. tubers.	Weight of small tubers.
Single eyes, cut shallow,	14	38	2 lbs.	1 lb. 13 ozs.
Single eyes, cut deep,	57	72	12 lbs. 10 ozs.	3 lbs. 3 1-2 ozs.
Ordinary cuts,	55	122	10 lbs. 9 ozs.	6 lbs. 4 1-4 ozs.
Whole potatoes,	43	134	6 lbs. 13 3-4 ozs.	6 lbs. 3 3-4 ozs.

On August 31 dug ten hills and photographed the yields. The figures as below, multiplying by two in order to have the figures comparable with the preceding table :

Seed Used.	No. merch. tubers.	No. unmerch. tubers.	Weight of merch. tubers.	Weight of small tubers.
Single eyes cut shallow,	16	46	1 lb. 2 ozs.	10 ozs.
Single eyes cut deep,	48	44	9 lbs. 8 ozs.	1 lb. 1 oz.
Ordinary cuts,	38	94	7 lbs. 3 ozs.	3 lbs. 0 ozs.
Whole potatoes,	42	186	7 lbs. 0 ozs.	6 lbs. 2 ozs.

A summary of these two tables may be arranged as below :

Seed Used.	No hills.	The merch. tubers averaged.	Small potatoes averaged.
Single eyes cut shallow,	20	1.6 oz. each, 1.2 oz. per hill.	.46 oz. each, .97 oz. per hill.
Single eyes cut deep,	30	3.4 oz. each, 9.2 oz. per hill.	.64 oz. each, 2.00 oz. per hill.
Ordinary cuts,	30	3.0 oz. each, 7.5 oz. per hill.	.74 oz. each, 4.14 oz. per hill.
Whole potatoes,	30	2.6 oz. each, 5.5 oz. per hill.	.68 oz. each, 4.95 oz. per hill.

SEED USED.	Tubers merch.	Per hill. small.
Single eyes, cut shallow,	0.7	2.1
Single eyes, cut deep,	2.7	3.1
Ordinary cuts,	2.8	5.6
Whole potatoes,	2.1	7.2

These results, all in favor of one hypothesis, that deep cutting of single eyes furnishes preferable seed for potato growers, receives corroboration from our field results. This exception will, however, be noted; our garden results deal with hills growing; field results with hills planted, of which many did not vegetate their seed.

2. One plat in the garden was surrounded by edgeing, and upon land now smoothed by spring rains whole potatoes were laid for seed and covered with six inches of straw. There were three rows each ten feet long, planted April 18. May 8 showed no signs of sprouting, the temperature of soil under straw 48°. June 9 vegetated, the ground under the straw very cold and wet. September 21 dug nineteen hills, the yield 16 pounds of merchantable and 3½ pounds of small potatoes.

On April 18 we boxed in two plats in the garden. Upon the unstirred land single potatoes were laid in three rows twelve feet long,

and one plat was covered with four, the other with six inches of coarse sand. On May 8, dug into the hills and found sprouting had commenced; the temperature of the soil under the four inches of sand being 54°, under the six inches of sand, 52°. Vegetation occurred upon both plats upon May 22. During the summer a number of hills were destroyed by digging, in order to study progress, and on June 12 we noted that the potatoes under four inches of sand were rather more forward than those under six inches of sand, and were very prolific; those under the six inches of sand more prolific than any other plat noted. On June 27 the potatoes under six inches of sand in bloom, and on August 24 some cooked were pronounced of superior quality. September 1, removed from two plants ten very large tubers; there were no small ones. September 21, dug these potatoes and found twelve hills covered with six inches of sand yielded twenty-two and one-quarter pounds merchantable, and one-quarter ounce small potatoes; the eighteen hills under four inches of sand yielded thirty-three pounds merchantable, and one pound of small potatoes.

The full significance of this yield can be best understood by giving in tabular form the yields of the nearest plat cultivated in the ordinary way, and all calculated to twelve hills:

	Merch. tubers.	Small tubers.
12 hills covered with six inches sand.	22 1-4 lbs.	1-4 oz.
12 hills covered with four inches sand.	22 lbs.	10 2-3 ozs.
12 hills, ridge culture..............	9 1-4 lbs.	3-4 oz.
12 hills, level culture..............	5 3-4 lbs.	1 lb. 11 ozs.

We shall return to these figures in a few paragraphs, in order to show their bearing upon a hypothesis we have formulated, as follows: For the best growth of the potato, we require to keep the tubers warm and dry; the roots moist and cool. To give a practical test to this theory we arranged the following experiment:

On April 24 we threw up some high ridges, four feet apart, and planted ordinary cuts, one foot apart on the ridge. These vegetated May 22. On June 7 we applied a mulching of four inches of moist straw between the ridges. The idea being that by high ridging we secured dryness for the tuber, by mulching the intervals we secured moisture and coolness for the roots. There was no hoeing or cultivation during growth, the weeds being simply cut away lightly with the hoe, so as to disturb the soil as little as possible. The yield of the 150 hills was 138 1-2 pounds of merchantable tuber, and 33 3-4 pounds of unmerchantable.

In this, and the preceding experiment with sand and straw, we have parallel series designed to embrace the points which shall open up to us some of the laws which regulate productiveness in the potato. In the straw, coolness and dampness during a portion of the growth; in the sand and in the mulched intervals, heat and dryness for the tuber, moisture and coolness for the roots. Let us bring together the results calculated to the 100 hills:

	Merch. tubers.	Unmerch. tubers.
Potatoes covered with straw....	84 1-4 lbs.	18 1-2 lbs.
Potatoes covered with sand.....	184 lbs.	3 1-3 lbs.
Potatoes on ridges, and the intervals mulched	92 1-3 lbs.	22 1-2 lbs.
Ordinary level culture	47 1-2 lbs.	14 lbs.
Ordinary ridge culture.........	83 1-2 lbs.	7 1-2 lbs.

We thus see a confirmation, so far as one trial is concerned, of the hypothesis. In the straw, coolness and dampness for root and tuber in the spring when dryness of the upper portion seems neither essential nor advantageous, for then vegetation is becoming established; in the summer, dryness without heat for the upper portion. In the sand, heat and dryness for the tubers, moisture and coolness for the roots. In the ridging and mulched intervals, a moderate amount of dryness (would have been greater in an ordinary season), and moisture and coolness for the roots. In the ordinary ridge culture on this soil, a greater approach to the condition which the sand supplied than in the ordinary level culture.

We may be pardoned, in view of the importance of these thoughts, if we depart from our usual plan, and call attention to a few practical remarks.

The question of level or hill culture may, after all, be but a question as to how to secure certain conditions. We may understand, with the help of these experiments given, that in clay soil ridging may secure in ordinary seasons those conditions which on loamy or sandy soil are secured better by level culture. In view of the agency of the seed used, and the effect of a greater or less fertility, or better or worse physical character of the soil as influencing, we must wait for further experiments for the verification of the results which one trial renders probable. Favorable condition of soil may sometimes offset improved methods of planting, and in this view the accidental use by us of land too poor to raise a good crop under ordinary circumstances, may possess its advantages. This land which could raise only a calculated crop per acre under ordinary level culture of 86·2 bushels, or under ridge culture of 151·5 bushels, yet, under theoretical circumstances, yielded upon the same soil at the rate of 334 bushels per acre.

3. One plant was divided into three parts in order to observe the effect of cultivation. Three rows were kept weeded by hand; three rows were hoed without hilling; two rows forked over deeply between rows. The yields were as below:

	Merch. tubers.	Small tubers.
Three rows (75 plants) not cultivated	48 lbs.	16 1-2 lbs.
Three rows (75 plants) ordinarily cultivated.	52 3-4 lbs.	20 1-4 lbs.
Two rows severely cultivated....	14 1-2 lbs.	8 lbs.

In every case a potato forms its tubers above its roots, and these tubers occupy the upper layer of the soil, while the roots pass downward and outward. Upon August 5, we washed out the roots of a potato plant growing upon a ridge, and the half potato used as seed put six inches below the surface. A trench was first cut across the ridge and carried to a sufficient depth. Then a force-pump was

brought into requisition, and by means of a forcible spray the soil was washed away from the potato plant until its roots were left exposed. One root was found to pass 34 inches below the top of the ridge, or 28 inches below the tubers, or 22 inches below the surface of the ground between the ridges. The roots were more fibrous, and branched deep in the ground than beneath the surface, and diminished very little in size after attaining a distance of six inches from the stem. The soil was a very heavy clay, and the soil at the bottom, where the longest root stopped, was a coarse gravel, closely cemented with clay. But few roots passed within the area of the soil that would be disturbed by an ordinary hoeing. Under these circumstances we cannot think but that the difference of yield between the uncultivated and ordinarily cultivated rows was but accidental, especially as the cultivation which extended within the root range appears to have been disastrous to the crop.

4. Seed ends and stem ends were planted April 18, two rows of each, the potato being cut in half, and each half being used in the opponent rows. The yield was:

	Merch. tubers.	Small tubers.
Two rows (50 plants) seed ends	54 1-4 lbs.	5 lbs.
Two rows (50 plants) stem ends	32 3-4 lbs.	5 3-4 lbs.

As we have previously shown, the yield of the potato depends greatly on the character of the seed. Had the seed used in this case been simply the extremities of the potato, instead of the potato divided in the middle, the results might well have been expected to have been reversed. On June 12, we remarked that the stem ends were later in forming tubers than the seed ends.

5. Potato skins are an illustration of eyes cut shallow. These form plants, and in very rich soil may furnish good yield. In our soil, however, the yields were but small, thus:

	Merch. tubers.	Small tubers.
Forty-four hills potato skins yielded	9 3-4 lbs.	1 3-4 lbs.

6. April 17, sprouts as broken from the potato tubers were laid horizontally within ridges, and covered two inches deep. Like sprouts also were set upright in level ground, the tops about one inch below the surface. On May 8, an examination showed these to be alive and putting up rootlets. The tips, however, in no case examined grew, but a new shoot appeared from the axil of a leaf scale. On May 17, vegetation appeared. On June 12, a number of plants were dug up and examined. The sprouts laid horizontal showed small foliage, but the tubers, few in number, larger than those from any other mode of planting. The sprouts set upright had also small foliage, and the tubers not as large as in the case of those laid horizontal. From this date, our diggings exposed no progress, the formation and growth of tubers proceeding very slowly, and every other method but one proving superior. We cannot help thinking, however, that in rich garden soil these sprouts would have given early tubers of excellent size. At harvest, September 21, the following yields were obtained:

	Merch. tubers.	Small tubers.
Fifty sprouts, laid horizontal............	13 1-2 lbs.	2 1-2 lbs.
Fifty sprouts, set upright..............	3 lbs.	4 lbs.

7. May 26, made 12 potato slips, and inserted the leaf stems up to the first pair of leaflets; also a second dozen, inserting the leaf stems so as to bring the first pair of leaflets below the ground. In June, transferred to the garden. The leaves of the majority showed life during the whole summer, but no growth; the roots, however, extended vigorously. The potato can be slipped at any portion of the leaf stem, although it slips more freely at the axils.

8. May 26, potatoes that were peeled very thickly and planted in dry sand formed shoots from the amputated eyes; others planted in moist soil failed to shoot. A potato, from which the eyes had been removed for planting, formed shoots which issued from the cavities. On August 2 dug potatoes from which the eyes had been removed in the spring. These had produced a small crop of tubers, and the seed pieces were almost as sound as ever. Miniature tubers or callosities were formed in the bottom of the hollows from whence the eyes had been removed, as also on the cut surfaces, especially along the line which marks the cambium region, and in one case even in the center of the tuber.

9. August 29 we found a potato stalk in the garden with one tuber growing from the axil of a leaf above ground. On September 1 a potato top, which had been pulled up and thrown on the ground on August 23, was found with some of the leaves dead, others green, and ten tubers formed upon the stem in the axils of leaves. These tubers were from a half to three-quarters inch in diameter. The specimen, preserved in alcohol, is now in our museum.

10. May 30 we placed a box frame two feet square about a hill of potatoes, worked some phosphate about the hill, and then filled the box with light soil, leaving the extremity of the potato plant protruding above the surface. During the season, as the potato plant extended in growth, additional boxes were added, until finally it had been forced upward by a hill four feet two inches high. The plant bloomed June 19, when the surface inside the box was twenty-two inches from the ground outside. On September 21 the boxes were taken away one by one, and the earth carefully removed. The stalk was found to have neither branched nor rooted, and just above the seed one potato weighing two and three-eighths ounces was found, and two of the size of peas. Evidently the whole strength of the plant had been spent in maintaining the upward growth forced upon it.

11. On July 11, by means of a cork-borer, a core coincident with the axis of the potato was removed. Vegetation occurred July 19. A similar potato, planted alongside, vegetated on July 22.

12. About June 10 some potatoes in a box in the shop-cellar were scalded by pouring upon them boiling water from the spout of a teakettle. On July 20 an examination showed that the shoots had been killed or injured, and a curious growth had taken place. In many tubers very numerous shoots had started from each eye — in one case as many as 103 on a single potato, and in one case twenty-five

from a single eye. On many tubers small tubers replace tne shoots, often twenty or thirty from a single eye. Upon cutting into many of the tubers the curious phenomena of potatoes growing within potatoes was observed, and in many cases these had cracked open the parent potato, and protruded from the surface. A careful examination showed that underground stems had developed from the axils of buds just under the surface or coincident with the surface of the potato, and penetrating the flesh of the potato had formed tubers at their extremities; that this development only took place when no shoots, or but few, had developed from the eye, and roots had developed; that stems formed within the structure of the potato, recognized as such by the leaf scales, may penetrate the whole depth and appear at the opposite side, forming at their base underground stems bearing tubers, and when reaching the atmosphere forming true leaves, the roots being external at the eye whence the shoots started. These in-potato stems are swollen and yam like, but are not structurally tubers.

On July 24 eyes from these scalded potatoes were planted. The eyes which had formed shoots came up well, while of the eyes that had formed tubers but two out of ten vegetated. On August 25 found that the eyes which had no tubers had formed some small tubers, and in some of those which had tubers when put in the ground, and which did not vegetate, the tubers had enlarged, absorbing the whole substance of the seed eye, but with neither roots nor leaf.

13. It has been a general observation with us that rarely more than three or four eyes develop when a whole uninjured potato is used for seed. Injury to the eye, however, seems to cause many shoots to grow. On June 12 but a single shoot had formed from a whole potato; this was broken off, and on June 26 it was noticed that six shoots had sprung from the previously undeveloped eyes.

14. On May 20, we planted in the garden several varieties of potatoes sent us for trial by Mr. M. F. Pierson, of Seneca Castle. The ground was clayey and not especially fertile, neither better nor worse, apparently, than the rest of our potato plats. The seed was cut to single eyes, of a large size. The yield was as below:

	Merch. tubers.	Small tubers.
46 eyes Extra Early Peach Blow, yielded,	8 lbs.	3 1-2 lbs.
62 eyes Mammoth Pearl, yielded,	47 lbs.	5 1-4 lbs.
89 eyes Doolittle's Ontario, yielded,	23 3-4 lbs.	3 1-4 lbs.
78 eyes Extra Early Gem, yielded,	46 lbs.	8 1-4 lbs.
40 eyes White Whipple, yielded,	26 lbs.	4 1-4 lbs.
76 eyes White Star yielded,	45 lbs.	4 1-4 lbs.

After this presentation we may review the field somewhat, and ask what we have learned:

From experiment 12 we find that single eyes are capable of bearing all the potatoes that can be expected to be grown in a hill.

From experiment 13, we find indicated, and indeed very many parallel observations made at various times adds a considerable certainty, that in planting whole potatoes or half potatoes, but few eyes normally develop growth. The addition of eyes planted in one piece does not therefore necessarily produce equivalent increase of stalks or plants from the seed. Using whole potatoes for seed, if done with the expectation of getting very abundant stalk, is therefore a waste, as the same potato cut properly to single eyes would produce greater results

by causing each eye to produce a stalk, or a conglomeration of stalks. We also remark from experiment 12 that injury to the eye, or from experiment 13, the breaking off of the growing shoot may cause eyes to develop which would otherwise remain dormant.

From experiment 1, we have strong indications, almost approaching certainty, that by cutting eyes so as to include the vegetative axis we derive a greater yield of crop than when this vegetative axis is removed in the cutting. That there are vital points in the potato which are capable of growth is shown by experiment 8, and the same experiment also shows that these lines of vegetative activity are coincident with a structure that can be easily recognized. That this region of an internal branch, for thus for convenience sake we call this internal structure which takes on the form of a stem with branches to which the eyes may be likened to terminal buds, is especially favorable to growth is shown in a positive manner by experiment 8, wherein the peeled potato is found to grow from the cut surface of these branches, and in a negative manner by experiment 5, where potato skins yield a small crop. We remark here, that if the potato seed be dug from the growing plant at the proper time, if absorption of substance has taken place, the line of absorption seems to follow definite tracks, and to show that in a measure each eye rules over its own territory.

From experiment 2, we derive support for a hypothesis that that system of cultivation which allows the tubers to be formed in warm and dry soil, while the roots occupy a cool and moist soil, is the most advantageous.

We may add here, as the result of several trials, that potato plants from single eyes growing in the house in a soil of the same temperature as the air did not form tubers, but when one of these plants was removed to the outside ground, tubers immediately formed.

From experiment 3, we derive indications that for the potato plant a system of cultivation which interferes with the roots is a disadvantage.

From experiment 10, we infer that a hilling which forces upward growth for a long time is disadvantageous to formation of tuber.

From experiment 14, we infer that varieties of potatoes are adapted to various conditions of soil, and that under unfavorable conditions one variety may be of far more advantage to grow than another. From the use of divided eyes for seed, on rich soil, detailed in experiment 1, we may infer that exceedingly favorable conditions in one direction may offset unfavorable conditions in another direction.

FORAGE CROPS.

In the spring season, various kinds of seed of sorghums, teosinte, cow peas, pearl millet, etc., were secured in order to test the value of their varieties for the purposes of forage.

The sorghum seed was obtained from Prof. Peter Collier, chemist to the Department of Agriculture, at Washington, and comprised sixteen kinds. The Dhoura was obtained of a seedsman. The seed was sown in drills, four feet apart, on June 3, the seed being distributed as uniformly as possible along the rows. All the varieties, except Dhoura, vegetated on June 15; the Dhoura on June 20. The other particulars may be represented in tabular form:

Variety.	Blossomed.	Ripe.	No. of plants in 10 ft. of row.	Weight of product of 50 seed. lbs.	Weight of 20 ft. of row. lbs.
1. African	Aug. 21	....	12	98 3-4	51
2. Iowa Red top	Aug. 18	Oct. 13	11	65 1.4	49
3. Neazana	Sept. 10	....	15	.....	48
4. Miller	Aug. 20	Oct. 13	25	54 1-2	52
5. Stump	Aug. 20	Oct. 2	22	81 1-2	52
6. White Mammoth	Sept. 25	....	16	150 3-4	63 5-8
7. Gray Top	Sept. 22	....	17	107 3-4	50 1-8
8. Link's Hybrid	Sept. 16	....	14	111 7-8	59 3-4
9. Regular	Aug. 21	....	17	86 3-4	......
10. Bear's Tail	Aug. 21	Oct. 13	21	54	45
11. Honey	Sept. 20	....	10	222	74 1-2
12. Honduras	Sept. 20	....	4	239 1-4	62 1-3
13. Gooseneck	Sept. 5	....	8	85	39
14. Liberian	Sept. 20	....	16	113 1-2	44 3-4
15. Chinese Sugar Cane	Aug. 24	Oct. 13	16	55 1-4	45
16. Early Amber	Aug. 21	Oct. 2	15	51 1-4	45
17. Dhoura (in hills)	Sept. 3	....	..	115	......

On July 15 we noted that the sorghums were all weak and not shading the ground, the weeds grew vigorously, this crop thus necessitating more hoeing than corn. On Aug. 9, after a warm spell of weather we first noted a vigorous growth. From this time on they developed very rapidly, and finally presented a large yield of foliage, exceeding that furnished by corn planted alongside, but planted later. Although measurement and weighing showed considerable difference, yet but little difference was apparent to the eye, and we were scarcely able, with one exception, to select the variety which looked the most prolific in foliage. This one exception was the Honey, which looked and perhaps was the most prolific of forage of any under test. The Dhoura was planted in hills, and its yield on this account should not be compared with that of the sorghums planted in drills. Twenty-five seeds produced seventy-two stalks. Honduras variety, through the non-germination of its seed, was very thin in row.

Pearl millet was sown in drills on June 3; vegetated June 15; in bloom September 6; the seeds scarcely ripe October 20, the day preceding the first killing frost of the autumn. The growth was slow, the leafage coarse, and it did not attain a size sufficient for cutting until so late in the season as to be in danger of injury from frost. On our soil, and in this year's climate it offers no promise of usefulness in the presence of so many better forage plants.

Teosinte was planted in drills on June 3, and vegetated June 15. There was no appearance of bloom. The growth was feeble and the plant flattened and tillered greatly; this feature continued as late as September 6, when a little upright growth was noted. This plant is entirely unsuited to our soil and climate.

Vetches or tares were planted in drills on June 3, and vegetated June 15. On July 29 a single bloom observed. In August seemed to languish and be affected by a rust, but in the latter part of the month a second growth started, far exceeding in vigor the first growth, and a second quite free blooming took place. On September 20 a few pods ripe. This plant seems scarcely vigorous or prolific enough to meet any demands that our farmers would be likely to make upon it. If it has any promise it is as a meslin crop, but such promise is indeed small. Our experience this year condemns Pearl Millet, Teosinte and Vetches as unworthy of further trial.

The Chinese bean, recommended by some seedsmen as a forage crop, was planted June 3, vegetated June 15, bloomed August 12, and was ripe September 15. This plant is not sufficiently leafy for forage, but is very prolific of narrow long pods filled with small compressed beans. It seems botanically to be a species of Vigna.

The Soja bean, *Soja hispida*, was procured of a seedsman and planted on June 3, but not a bean germinated. Through Mr. Saze, a Japanese student at Cornell University, we procured a few beans and planted three rows of ten feet long, the seed six inches apart in the three feet drills. Planted June 9; these vegetated on June 19, blossomed August 13, and were called ripe September 25, although the pods were not yet turned brown. We noted that when vegetation took place the cotyledons, instead of withering as do those of common beans, developed into leaves. Blooming disclosed a very minute white flower. On August 31 we remarked upon the great vigor of the plant, the tallest plant then being three feet, the shortest two feet three inches, the foliage abundant and dense. Pods very abundant, hairy, as is the plant, and containing two beans each. Of excellent promise as a forage plant, even if the beans are not acceptable to our palate. Planted upon unmanured soil, and receiving no pampering care, the possibility that this plant may develop into use seems good. A further trial on a larger scale is necessary, however, to justify positive conclusions.

Having heard much of the cow pea of the South, it seemed to us advisable to give this plant a fair trial. A bushel of mixed seed was procured from the South, and eight varieties were hand-picked therefrom, which we distinguished as below:

	Planted.	Vegetated.	Bloomed.	Seed ripe.	Seed gathered
1. Green-eyed white,	June 3.	June 13.	Sept. 4.	Oct. 21.	Oct. 21
2. Black-eyed white,	June 3.	June 13.	Aug. 31.	Oct. 21.	Oct. 21
3. Brown-eyed white,	June 3.	June 15.	Sept. 6.	Oct. 21.	Oct. 21
4. Black...........	June 5.	June 15.	Sept. 4.	Oct. 21.	Oct. 21
5. Light speckled...	June 5.	June 14.	Aug. 13.	Oct. 21.	Oct. 21
6. Dark speckled ...	June 5.	June 14.	Aug. 9.	Sept. 4.	Oct. 4
7. Red	June 5.	June 14.	Aug. 9.	Oct. 21.	Oct. 21
8. Black and white..	June 5.	June 15.	Aug. 9.	....	Oct. 4

Prof. Gulley, of Mississippi, to whom we showed our seed, identified the No. 7, red, as the Red Clay Cow Pea; No. 2, the black-eyed white, as the Crowder Pea of the South. These seed were filled with weevils, as we discovered later in the season, frequently two weevils to a pea. The pods upon all the varieties ripened up very unevenly, so that it was difficult to note the ripening.

On August 31, the green-eyed white cow pea, upright in growth, very leafy, and very much foliage, it ripened only a few pods. The black-eyed white, but little foliage and quite prolific of pod. The brown-eyed white has much foliage and is of a spreading growth, it ripened but a few pods. The black is less leafy, and quite prolific, averaging well for leaf and seed. The light speckled has moderate foliage and ripened many of its pods. The dark speckled has moderate foliage and is prolific of seed. The red is rather upright in growth, and very leafy, it ripened but few pods. The black and white enormously prolific of pods.

On one plant of the black and white, sixty-five pods, many o which contained twelve beans, were counted on September 4. A vigorous plant on September 30 had sixty-one ripe and six unripe pods; the ripe pods containing 634 seeds.

The green-eyed white, the brown-eyed white and the red offer promise as forage plants; their growth is exceedingly vigorous when planted in drills and hoed, and their growth continued until October 21, when they were cut down by frost. During September, and later, the spread of the foliage obliterated the intervals of four feet between the drills. This year they ripened but very few seed with us, giving but scanty bloom.

None of the varieties which were sown broadcast did well. It is only the hoed peas that offer promise, and we are yet in doubt as to their adaptation to our climate. This year's trial certainly does not condemn, and as certainly does not prove their value here. If doing as well as they have in this exceptionally cool summer, what may we expect from a hot summer? Trial alone can determine. The Black and white and the black speckled varieties may possibly find use as a grain crop, to be grown for feeding animals. Their prolificacy recommends them, the chemical analysis of the bean shows much nitrogenous constituent, but will cattle eat them? Until we know whether cattle will eat the green or dry forage of the cow pea, it would seem unnecessary to speak of their value as an ensilage crop, for which their chemical analysis would seem to offer prospect.

From China a portion of the sorghum seed sent to this country by Minister Angell was presented us by Prof. Collier, and the varieties only known to us by numbers. From India, two varieties. These sorghums are not claimed to be sugar sorghums, but to have been raised for forage and seed from time immemorial. Each kind was planted by itself and carefully attended.

Chinese No. 1—Planted June 2; vegetated June 19; bloomed October 5; no seed ripened. Has a white midrib to the leaf. Habit of plant dwarf, scarcely four feet high. Offers no promise of being worthy of culture.

Chinese No. 2—Planted June 2; vegetated June 15; bloomed August 20; seed ripe October 20. The plant is tall, branches at the nodes, and these branches forming in some cases seed heads, and is quite leafy. Very prolific of seed. This variety offers considerable promise as a seed and forage sorghum.

Chinese No. 3—Planted June 2; vegetated June 19; bloomed October 13; no seed ripened. Seeds vegetated feebly, and not enough plants grew to form an estimate of its character.

Chinese No. 4—Planted June 2; vegetated June 15; bloomed September 1; seeds ripe October 20. Similar in habit to No. 2, and bearing a very large head of seed.

Chinese No. 5—Planted June 2; vegetated June 15; blossomed September 20; no seed ripened. Of little promise of value.

Chinese No. 6—Planted June 2; vegetated June 16; bloomed September 14. Seed in milk October 21, when frost occurred. The seed-top quite bushy, resembling broom-corn. Growth tall; foliage rather abundant.

India No. 29—Planted June 2; vegetated June 16; bloomed Sep-

tember 11; ripened some seed October 13. Seed slightly mixed. Not particularly noticeable for any quality differing from the ordinary run of named varieties.

India No. 30 — Planted June 2; vegetated June 16; bloomed September 20; seed did not ripen. Short and backward; tillers considerably, and quite leafy; plant dwarf, scarcely four feet tall. Offers no promise of value.

Our grass plats of ten feet square attracted much attention from visitors. These plats were in a line, and on April 10 eighteen kinds were sown in drills one foot apart.

No. 1. *Dactylis glomerata* — Orchard Grass. Vegetated May 2. Grew vigorously and well, but gave no bloom. Appears from first year's seeding as a very good early pasture grass.

No. 2. *Avena elatior* — Tall meadow Oat Grass. Vegetated May 4. Headed June 28, and bloomed a few days later. A rather coarse grass, with scant foliage.

No. 3. *Bromus Schraderii* — Rescue Grass. Vegetated May 3; headed June 28, and bloomed a few days later; seeds ripe July 29. Seeds gathered, and the plant cut down to the ground, and on August 20 the second growth noted as larger than the first growth of many other grasses. On September 4, headed for the second time. This is a coarse, vigorous grass. Not prepossessing in appearance as compared with many of our common grasses.

No. 4. *Lolium Italicum* — Italian Rye Grass. Vegetated May 2; bloomed July 3. A close growing, dense, succulent grass, and would be pronounced upon favorably for lawn or pasture, were we not acquainted with the general opinion that it only endures for one or two years. Its succulency lasts into the late autum.

No. 5. *Poa pratensis* — Kentucky Blue Grass. Vegetated May 8; and made but a feeble growth, not coming into bloom. As this grass grows luxuriantly on the Station farm, these plat results seem surprising.

No. 6. *Festuca elatior* — Tall Fescue Grass. Vegetated May 2; bloomed July 7, but a few heads growing, and no seed noted as ripening. This is a dense, vigorous, succulent grass, affording a vast quantity of short herbage, keeping its succulency well into the autumn, but indication of a bunching habit to the stools. One year's trial, and this the year of seeding, certainly gives indication of value to this grass for pastures..

No. 7. *Agrostis vulgaris* — Red Top. Vegetated May 2; headed June 28, and shortly after in bloom. The seed badly mixed. The growth not vigorous, and this trial showing no especial value; for some reason it did not prosper with us.

No. 8. *Festuca pratensis* — Meadow Fescue. Vegetated May 2; bloomed August 13. Growth moderately vigorous, but developing no points worthy of special notice. If of value, it would be as a mixture with other pasture grasses, as the leaves and herbage are fine and succulent.

No. 9. *Poa trivialis* — Rough-stalked Meadow Grass. Vegetated May 8; bloomed July 6. Seed germinated very poorly, and the plants which came made but a feeble growth.

No. 10. *Alopecurus pratensis* — Meadow Foxtail. Vegetated May 2; bloomed July 7. Grew with but moderate vigor.

No. 11. *Festuca tenuifolia* — Slender Foxtail. Seed did not vegetate.

No. 12. *Agrostis Stolonifera* — Creeping Bent Grass. Seed failed to vegetate. On July 1, replanted this plat with Bermuda grass seed presented by Messrs. Thorburn & Company, but the seed of this also failed to vegetate.

No. 13. *Poa nemoralis* — Wood Meadow Grass. Vegetated May 8; bloomed July 11. Seed vegetated but feebly, and the growth very small.

No. 14. *Agrostis canina*—Rhode Island Bent Grass. Vegetated May 8; bloomed July 29. Made a good growth, but the foliage a little harsh.

No. 15. *Poa aquatica*. Seed failed to vegetate.

No. 16. *Anthoxanthum odoratum* — Sweet Vernal Grass. Vegetated May 3; bloomed July 3. A dwarf, leafy, hardy grass, of little value except possibly for pasture use as an aromatic food.

No. 17. *Festuca ovina* — Sheep Fescue Grass. Vegetated May 4, but did not bloom. The seed vegetated poorly, and the growth was feeble. This grass gives no appearance of especial value.

No. 18 *Lolium perenne, var. Pacyi* — Pacy's Ray Grass. Vegetated May 2, bloomed very scantily September 4. This grass showed throughout the season, even into the late autumn, a remarkable growth and succulency, evenness of foliage, and freedom from tufting habit. The narrow drill-mark seeded furnished plants which, in some rows, obliterated all the spaces. This first year's trial justifies the greatest expectation that this grass may be found of extreme value for lawns and pastures.

Our remarks upon the forage plants and grasses are founded upon our experience this year, and the conclusions arrived at, and statements made, are subject to the modification of future trials.

Alfalfa and Lucerne.

On April 19, planted two plats of lucerne and alfalfa. Both vegetated on May 2, or in thirteen days. The temperature of the soil at date of planting, taken at seven A. M., was 45° at one inch depth, and 52° at three inches depth. The growth of the alfalfa was slightly more vigorous than that of the lucerne, but on June 30 we record both as suffering from a sort of blight, the upper leaves turning yellow and wilting. On July 11 the alfalfa was in scanty bloom, while on July 27 the lucerne had not yet bloomed. This backwardness caused by the blight, which seems to have checked growth and development on both sorts. We must not, from one trial, conclude that these "clovers" are unsuited to this soil or climate. In August, however, a second growth, more promising than the first, took place.

The lucerne, of Europe, and the alfalfa, of California, are the same plant — *Medicago sativa*. Both have been highly commended as a forage plant in those climates and soils which are adapted to its growth. According to the ancient writers, it was introduced from Media into Greece in the time of Darius, and thence into Italy. Columella estimated it as the choicest of forage plants, because it yielded perennially and afforded four, five or six crops in a year. It is now

highly esteemed in the south of Europe, as well as in Chili, Peru and Brazil, from whence it was apparently sent to this country before 1850, under the name of Brazilian clover. The seeds, under the name of lucerne, reached the United States as early as 1800, about which time Chancellor Livingstone tried it at his estate at Clermont, Columbia county, N. Y., and in 1824 some specimens were sown near Boston, which maintained themselves for many years. The seeds of alfalfa, from Chili, were distributed from the United States patent office in 1853, and alfalfa is now reported as being the favorite grass of California, and as also succeeding well in Nevada, Nebraska, Utah and Colorado. Although a plant of warm climate, yet under favorable circumstances of soil it seems to do well even as far north as this State; but it requires a deep, loose, sandy soil, and to be kept free from weeds.

When cut early before the stalks become woody, it affords a nutritious hay, well spoken of by all writers on agriculture, for the feeding of milch cows and horses. The analyses by Ritthausen of plants grown at Mockern give the following results :

	Water.	Nitrogen substance.	Non Nitrogen substance.	Woody fiber.	Ash.
Before bloom........	81·9	6·2	6·0	4·0	1·0
Beginning of bloom..	72·5	4·9	6·0	13·4	2·4

The ash analysis by Anderson gives 2·49 per cent of ash, containing 7·80 per cent of phosphoric acid and 33·16 per cent of potash together with 14.02 per cent of chloride of potassium.

There seem to be several varieties of lucerne. The alfalfa, as grown at the Station, scarcely differs from lucerne. Afghan lucerne is described by Gould as somewhat larger in growth and earlier than lucerne, but soon becoming indistinguishable from the common kind. Brazilian clover seems to be but a name under which seed of alfalfa was distributed.

THE RELATION OF SEED TO QUALITY IN FRUITS.

In founding a science the first attempt must be the collecting of facts upon which hypotheses may be formulated for the purpose of suggesting the laws which apply, and which hypotheses are to be retained until, after serving their purpose, they give place to theories. Thus, in studying the laws which affect vegetable reproduction, form, and quality, we must secure various facts which, however unimportant they seem by themselves, yet must possess values in their relations. It seems probable, almost certain, indeed, that every change in a plant produced by art is followed by various collateral changes which tend to mask influences, and which perhaps can be used to measure the potency of influences. Goethe and St. Hilaire a long time ago formulated a law that nature spares in one direction in order to expend in another. Thus, then, in gaining potency of fruit we should expect weakness in seed, in exaggeration of bulb, a deficiency in leaf, etc. For illustration, the Baldwin apple as compared with the wild fruit is nearly seedless. The ornamental beet, with enormous leaf-stalk and leaf, has but a small root as compared with the garden beet.

Should this correllation be found a true one, then in formulating its relations we have offered to us a means for securing a more certain advance in the development of improved food quality in our fruits and vegetables. If there is a diminution of size of seed found correllating with the hardness of head and tenderness of quality in cabbage, then by selection of small seed from the hybridized blooms for the new attempt we have more chances in favor of a successful outcome than if we worked after a more haphazard manner. If improvement in heading quality is correllated with a smallness of seed production then we have opportunity to improve through the selection of seed from plants of the least seed fertility. If in lettuce this relation is found to exist, then we have a means worthy of trial offered to our attempts to form lettuce of greater cabbaging head and superior tenderness. Thus, in fruit, if this relation is accurately determined, then we may hope, through selection of individual seed based on this knowledge, to secure a far larger percentage of success than if our attempt was guided by a no real order, but by imaginary reasoning. Indeed, as far as we have investigated, it seems quite possible that the successful formation of new varieties through hybridization is to be accounted for in a large measure by certain correlations, as hybridized seed is often inferior in appearance to seed from the parent species.

Our own studies in this direction, previous to our connection with the Station, gave origin to the following reasoning: In animals we find castration productive of tenderness of flesh and increased growth; that is, the period of immaturity with its corresponding succulence of tissue is prolonged throughout life. The animal grows old, but the growing old is not accompanied by that hardening and condensation of tissue which is peculiar to the species. In plants we note cases where the same rule seems to hold good. The banana, a seedless fruit of great lusciousness: occasionally seeding and the fruit then dry and inedible. The wild grape with a hard pulp and large seeds; our improved varieties with small seed and softened pulp; the seedless varieties usually described as of tender quality and delicious flavor.

In nature, as a general occurrence, with many exceptions, the plant depends upon its seed for the perpetuation of its species, and as a useful part of the plant the seed has a tendency to constantly appear, but under the law of natural selection we have also as an antithesis that useless parts have a tendency to disappear; hence as a seed loses its importance it is apt to lose its functions and identity, and art encourages development of a fruit in a manner counter to the best interests of the seed, and often encourages tenderness of quality of parts in species which in nature might be far better served by hardness. As castration produces tenderness, so as an antithesis tenderness would imply a counter effect upon the seed, approaching in its character the total deprivation which we call castration.

In order to follow out this line of thought experimentally, the Station staff in off moments have weighed, counted, measured and classified results as expressed in the following table.

Strawberry.	Number of specimens.	Seed to a berry.	Weight of seed.	Weight of fruit.	Seed. Maxima and Minima number to a berry.
Monarch of the West......	10	232	...	....	......
Sharpless	3	239	....	....	......
Triumphe de Gand........	1	152	....	....	......
Hervey Davis	10	115	....	....	......
Wilson's Alb'y (sm. samples)	10	72	....	....	......
Raspberry.			grs.	grs.	
Davidson's Thornless......	10	34·2	1·1	·11	......
Clarke....................	10	57·6	....	25·5	63—42
Caroline	9	47	....	23·3	60—40
Currant.					
Cherry	10	14·1	1·2	18·3	18—9
Red Dutch................	10	4·8	·6	5·9	11—1
White Dutch..............	10	9·8	·8	8·3	19—1
Cherry, large berries	50	15·2	....	....	28—7
Cherry, one large bunch....	7	20·0	....	20·4	26—14
Huckleberry.					
Vaccinum (?)	26	9·2	....	....	11—8
Mandrake.					
Podophyllum peltatum	4	22·2	....	....	35—14
Podophyllum peltatum	Many	....	....	....	35—5

Tomato.	Numb'r of specimens.	Seed to a berry.	Weight of seed. Grs.	Weight of fruit. Grs.
Turks' Cap..........	1	86	3	524·6
Mayflower	1	244	6·5	1,419·7
Early Acme.........	1	491	24·7	3,449
Trophy	1	476	22·6	3,208·3
Paragon	1	531	21·6	3,834·8
Fig	1	61	1.2	416·6
Yellow Plum	1	89	·7	416·6
Melon.				
Hackensack	1	550	273·4	29,181
Christiana	1	527	250	20,617
Christiana	1	617	277·7	17,962
Christiana	1	....	259·2	17,438
Christiana	1	393	175·9	17,283
Shaw's Golden Superb	1	494	203	12,632
New Surprise........	1	461	279·3	16,188
New Surprise........	1	591	192·9	10,030
New Surprise........	1	539	219·9	11,111

Grape. Twenty Iona grapes from one bunch had forty-five seed. Extremes one and four to a berry, as follows: four had one seed; ten had two seed; three had three seed; three had four seed. Thirty Isabella grapes from one bunch had fifty-one seed. Extremes one and three to a berry, as follows: Twelve had one seed; fifteen had two seed; three had three seed. Thirty Catawba grapes from one bunch had seventy-five seed; eleven had two seed; ten had three seed; five had one seed; three had four seed, and one had six seed.

Cherry.	Number of samples.	Weight of fruit. grains.	Weight of dry pits. grains.
Delicate	10	83·9	3·5
Elliott's Favorite	10	49·9	3·5
White Mazzard	10	27	3.5
White Bigarreau	10	73	4·2
Buttners	10	51·2	2·8
Elton	10	74.3	4·6
Burr's Seedling	10	58·8	5·3
Governor Wood	10	52	5
Downton	10	46·4	3·5
Black Heart	10	59·9	3·6
Black Tartarean	10	68·5	6
Black Eagle	10	52·8	4.9
Coe's Transparent	8	51	2·5
Champagne	10	44·4	4
Black Mazzard	10	18·9	3

In examing the stones of the cherry many of the pits were found abortive, as in the following table:

	Good seed.	Poor seed.	Total.
Black Tartarean	19	11	30
Elton	17	3	20
Governor Wood	15	15	30
Black Eagle	25	5	30
Burr's Seedling	2	28	30

Plum.

	Number of sa'pl's.	Av'ge wt. of fruit. grains.	Wt. of dry pits. grains.
Smith's Orleans	10	736.0	18.2
Jefferson	10	348.4	8.5
Frost Gage	8	245.3	8.6
Suisse	10	439.0	13.4
Fellenburg	10	383.5	17.0
Golden Gage	10	379.6	13.9
Bingham	10	511.8	25.1
Blecker's Gage	10	279.3	13.9
Hudson's Gage	10	254.9	13.1
Pond's Seedling	10	517.7	19.0

The following figures were obtained with fruits, and to these are added for apples the summary of other results obtained by myself or reported to me, and published in my paper read before the Society for the Promotion of Agricultural Science, at their Cincinnati meeting.

In noting the facts of tenderness or otherwise, our notes were made before exposing the seeds:

	Carpels.	Av'ge g'd s'd.	Ab'rt'e seed.	Wt. of seed. Grs.
10 Valencia oranges, texture rather tough....	10–12	12.8	1.5	40.0
15 Valencia oranges, texture tender.........	8–12	8.8	1.6	29.8
5 Florida oranges, texture tender.........	10–11	6.2	0.8	18.6
2 Florida oranges, texture rather tough.....	10–11	11.0	1.5	47.7

	Av'ge wt. ounces.	Av'ge wt. Av'ge of seeds. grains.	Av'ge No. plump seed.	Av'ge total seeds.
26 Baldwin apples, Geneva grown........	4·38	3·67	3·42	5·65
26 Baldwin apples, miscellaneous........	5·49	3·74	2.83	5·39
15 Baldwin apples, Conn. grown.........	4·7	3·84	5·84	6·50
5 Seckel pears, Geneva grown...........	1·5	5·2	4·8	9·2
5 Buffum pears, Geneva grown.........	2·9	6·17	6·2	10·0
1 Flemish Beauty, Ithaca grown........	5·5	7·71	4·0	6·0
1 Howell pear, Ithaca grown...........	3·7	3·39	4·0	9·0

WEIGHT OF SEEDS.

In the following table the Station weighings were of seeds of our own raising, from identified varieties, and all absolutely air dry. A few weighings indicated by a star (*) are those published by the Connecticut Experiment Station, but the seeds used were in most cases, except the onion, not *known* to be true to name. The weighings originally expressed in grammes, but calculated in grains:

	One hundred seeds of.	Weighed, grains.
Barley,	Chevalier *..................................	33·61
Broccoli,*	....	5·61
Cabbage,	Bacalam Late *..............................	5·91
	Large Brunswick *...........................	4·27
Carrot,	Wild, from Geneva...........................	1·32
	Half-long Luc (annual seed)................	3·38
	Early French Short Horn *..................	1·41
	Large White Belgian *.......................	1·74
	Large Orange *................................	1·74
	Jame's Intermediate *........................	1·44
Celery,	Incomparable Dwarf White *................	0·48
Clover,	" Western Seed " *..........................	2.05
	Western Seed, marked " extra " *..........	2·34
	Medium Clover.................................	2·36
Egg Plant	New York Improved........................	3·08
	Black Pekin...................................	3·98
	Early Long Purple............................	7·03
Lettuce,	Boston Curled.................................	1·32
	White Cabbage...............................	1·49

	One hundred seeds of	Weighed, grains.
	Tennis Ball	1·83
	Curled Simpson	2·01
	All the Year Round	2·04
	Hanson	2·20
	Hanson, from headed plants	1·16
Martynia,	M. Proboscidea	70·37
Melon,	New Surprise	41·97
	Christiana	49·0
	Hackensack	51·69
Okra,	Dwarf Green	37·1
Onion,	White Globe *	5·91
	White Globe *	5·98
	White Globe	4·99
	do from grafted plant	3·97
	do from ligatured plant	4·05
	do from compressed stalk	3·48
	Wethersfield Large Red, crop of 1870 *	5·55
	do. crop of 1876 *	6·41
	do. crop of 1877 *	5·30
	do. crop of 1878 *	5·77
	do. crop of 1879 *	6·03
	do.*	4·45
	do.*	6·42
	do.*	5·99
	Yellow Dutch *	5·44
	Yellow Danvers *	5·05
	do. crop of 1879 *	5·05
	do.*	4·10
	do.*	5·54
	do.*	6·25
	do.*	5·41
	do.*	5·24
	do.*	5·15
	White Portugal, crop of 1879 *	5·74
	do.*	5·60
	White Silver Skin *	5·57
	Yellow Globe Danvers *	5·80
	Red Globe *	6·65
	Large Red *	6·09
	Large Red *	5·75
	Extra Early Red *	5·95
Parsnip,	Wild, from Geneva	7·22
Pea,	British Queen	637·3
	Blue Imperial	634·2
	White Marrowfat	631·1
	Bishop's Long Pod	617·7
	Black Eyed Marrowfat	617·2
	Hair's Dwarf Green Marrow	597·2
	Day's Early Sunrise	594·9
	Culverwell's Telegraph	578·7
	Laxton's Marvel	563·2
	Eugenia	520·0

	One hundred seeds of	Weighed, grains.
	Tall Gray Sugar	486·1
	McLean's Blue Peter	479·4
	McLean's Little Gem	469·1
	William the First	447·5
	Tall Sugar	446·7
	Champion of England	435·3
	Extra Early Alpha	429·0
	Dan'l O'Rourke	428·2
	Premium Gem	427·4
	Wrinkled Sugar	416·6
	American Wonder	415·1
	Laxton's Long Pod	410·4
	Thorburn's First and Best	405·4
	Napoleon	399·8
	Bishop's Dwarf Prolific	399·6
	Kentish Invicta	394.2
	McLean's Advancer	388·5
	Philadelphia Extra Early	378·0
	Dwarf Gray Sugar	365·7
	Laxton's Earliest of All	335·6
	Tom Thumb	313·2
Pepper,	Small Red Chili	5·07
	New Cranberry	5·53
	Cherry Red	7·64
	Long Red Cayenne	9·02
	Orange Bell	9·09
	Long Yellow	10·39
	Tomato Shaped	10·74
	Large Bell	11·36
	Sweet Mountain	11·95
Radish,	Turnip rooted	15·51
	California Mammoth	17·79
	Chinese Winter White	18·06
Salsify,	(annual seed)	19·48
Scorzonera,	(annual seed)	10·16
Spinach,	Round or Summer	14·26
	Prickly or fall	20·61
Timothy*		0·486
Timothy*		0·575
Tobacco,	Havana	0·19
	Turkish	0·46
	Latakia	0·55
Tomato,	Red Cherry	1·85
	Pear	3·31
	White, from South America	3·81
	Turk's Cap	3·84
	Paragon	4·06
	Mayflower	4·39
	Early Acme	4·45
	Yellow, from South America	4·97
	Trophy	7·28
Turnip,	Yellow Swedish *	4·43

	One hundred seeds of	Weighed grains.
	Large White Flat Norfolk *	3·46
	Russian *	4·54
	Purple-top Strap leaf	2·99
	Early White Flat Dutch Strap leaf *	2·41
Wheat,	Lancaster	52·53
	Silver Chaff	52·34
	Mediterranean	51·34
	Red Amber	49·90
	Treadwell	49·15
	Treadwell Bearded	49·13
	Clawson	48·76
	White Eldorado	48·64
	Swamp	48·25
	Velvet Chaff	47·88
	Hungarian White Chaff	47·74
	Rice	46·47
	Yellow Blue-straw	46·36
	Grecian	46·17
	Finley	45·77
	Scott	45·23
	Smith's Improved	44·32
	Soudomska	44·12
	Egyptian	43·56
	York White Chaff	42·71
	Smooth Scott	42·53
	Travis	42·46
	Washington Glass	41·82
	Champion Amber	41·71
	German Amber	40·48
	Russian Spring	39·75
	Golden Straw	39·41
	White Blue-straw	38·22
	Zimmerman	37·73
	Fultz	36·86
	Tappahannock	35·50
	Theiss	35·46
	Russian May	31·08

Weeds.

The prolificacy of weeds could but excite our attention, as the fight with them was being waged day by day. The field selected for summer fallow had, on June 13, twenty-four species of weed growing on it in abundance. On June 22 a single square foot of soil in the garden, which had been plowed and harrowed in the spring, contained 356 growing plants, comprising seven distinct species, not counting the clovers and grasses. A careful count in June of the species of plants growing abundantly as weeds in the various fields gave:

Weeds of the forage plat	24 species.
Weeds of the lawn	13 species.
Weeds of the field	30 species.
Weeds of the garden	23 species.

It is difficult to decide what is an average plant in species which change so greatly in luxuriance according to their opportunity for growth. In offering figures the word "average" will be used as applying to those growing on the Station farm.

Shepherd's Purse — *Capsella Bursa-pastoris.* June 21. An average plant contained about 1,000 pods; each pod at least twenty seeds, and more bloom to come. A better specimen showed 2,200 pods, and still blooming; a vigorous specimen had 4,400 pods, and more to come. The number of seed to a plant may, therefore, be estimated at from 20,000 to 80,000.

Mallow —*Malva rotundifolia.* June 21. A fair specimen had 1,100 blossoms, each producing fifteen seed, and much more bloom to come. A fair estimate at least, seeds, 16,500.

Chickweed — *Stellaria media.* June 21. A fair specimen showed one hundred and twenty-three flowers and capsules, each capsule containing from seven to ten seed. A better plant had four hundred and seventy-one blooms or seed cases, and more yet to come. This plant continues blooming and seeding through the whole season. A fair estimate of seed to a plant at one time, therefore, 1,000 to 4,000.

Corn Speedwell — *Veronica arvensis.* June 21. One plant showed forty-three pods, and ninety seed to a pod; a more vigorous plant had 175 pods, and about 101 seed to a pod; another plant had seventy-eight pods, and another 123. The number of seed to a plant may therefore be estimated as from 3,800 to 15,700.

Thyme-leaved Speedwell — *Veronica Serpyllifolia.* June 23. One plant had 142 pods, one pod fifty-eight seed. The number of seed to the plant estimated as 8,000.

Black Mustard — *Sinapis Nigra.* A fair, rather smallish plant, had 120 blossoms and pods, and one pod fifteen seed. The number of seed to a plant may therefore be put at 1,800.

Dandelion — *Taraxacum dens-leonis.* June 22. Each head of a dandelion flower contains about 120 seed. It is a very poor plant that does not give ten blooms to a root. The number of seed to a plant may be estimated as much over 1,200.

Curled Dock — *Rumex Crispus.* June 22. A fair sample had nine stems. One stem selected as an average one had twenty-one flower-spikes. One average flower-spike counted 369 blooms. A single stem had then about 7,749 blooms, and the nine stems, 69,700. A larger plant had ten stems; the largest stem, forty-one seed-spikes, the smallest, twenty seed-spikes. The largest spike had 630 whorls of seed, the smallest, 219 whorls. The computed number of seed, therefore, 93,390.

Corn Cockle — *Lychnis githago.* July 1. A vigorous plant had sixty buds and blossoms. Two seed-pods had forty-nine and sixty-two seed, respectively. The seed may be computed at 3,300.

Ox Eye Daisy — *Leucanthemum vulgare.* June 25. A bloom of average size contained 802 achenes; another, 895 achenes. One plant had seventy-two, and another 120 blooms. While but quite often there is but one stem, yet frequently there are more to a root, up even to twenty-three counted. One stem may have thirteen blooms. The number of seed to a plant may therefore be computed at from 800 to 96,000.

Chess— *Bromus secalinus*. July 6. A fair stool had 211 heads, and an average head 18 seed. The number of seed, therefore, estimated at 3,798.

Corn Chammomile—*Anthemis arvensis*. July 6. A fair sample had 151 seed to a flower and 48 flowers to a stalk. The plants had from 1 to 10 stalks. The seed can be estimated at from 7,000 to 70,000.

Plantain— *Plantago major*. July 12. A vigorous plant had 8 flower spikes. One of these, not the largest, had 561 flowers. The number of seed to the plant can be estimated at 4,488.

Pig weed— *Chenopodium Album*. August 29. An average sized plant had 28 branches; one branch had 21 branchlets; an average branchlet had 13 flower spikes; an average flower spike 108 seed. The number of seed computed to this plant is therefore 825,552.

Purslane—*Portulacca oleracea*. September 28. A vigorous plant had 9 principal branches; an average branch had 15 branchlets; an average branchlet 212 seed capsules; one capsule had 75 seeds. The number of seeds to this plant can therefore be computed at 2,146,500.

Implement Trials.

But few trials with field implements were made. One on April 17th of a Post & Sharp plow sulkey, presented to the Station by the makers. The control over the plow was very efficient, the sulkey working as well when the plow was set to do poor work as when hung for better work. The furrows were cut from two to eight inches deep, and of various widths, and were all cut as designed. Pebbles or small boulders in the soil offered no obstruction, the plow either turning them out or else passing over or to one side of them and at once entering the soil. The soil beneath the plow sole was left soft, and so far as could be determined by watching the horses, the draught of the plow appeared less when attached to the sulkey than when run independently.

On May 18th a North-western corn planter was given us. We were unable to use this on the field, but careful trial showed it to be a reliable tool for dropping corn. Its defects, if it be a defect, is common to this class of planters; it does not firm the soil over the planted seed.

August 8th four wooden forks were received from Alba Kendall of Altay, N. Y. These are well-made tools, very desirable for handling barley straw and for use in the stable, the wooden tines being far safer than an ordinary pitchfork.

On September 16th tested Ansley's potato digger. The soil was very hard; some of the potatoes had green tops, in other rows the tops were dead. The draught as shown by the dynamometer was from 350 to 600 pounds. The work done was in every respect superior. Every potato was left on the surface, and in the case of the green topped plants, the potatoes left adhering to the tops and uncovered.

We were this year kept too busily employed in the details of organization to make extended trials of implements used. Remington plows, presented by the manufacturers, were used upon several of our fields

and gave excellent satisfaction. We endeavored to take time to carefully estimate their work, but were unable to do so. The La Dow harrow was also found a most valuable implement in practical use, as was also the Thomas smoothing harrow.

LIBRARY ACCESSIONS.

Sutton, Francis, F. C. S., F. I. C. A Systematic Hand-book of Volumetric Analysis, 4th edition. Philadelphia, 1882.

Fresenius, Dr. C. Remigius. Manual of Qualitative Chemical Analysis. Translated into the new system and newly edited by Samuel W. Johnson, M. A. New York, 1882.

Fresenius, Dr. C. Remigius. A System of Instruction in Quantitative Chemical Analysis. Edited by O. D. Allen, Ph. D., with the co-operation of Samuel W. Johnson, M. A. New York, 1882.

Gerber, Dr. Nicholas. Chemical and Physical Analysis of Milk, Condensed Milk, Infants' Milk Foods, with special regard to Hygiene and Sanitary Milk Inspection. Translated from the German and edited by Dr. Hermann Endemann. New York, 1882.

Wanklyn, J. Alfred, M. R. C. S. Water Analysis. Fifth edition. London, 1879.

Bell, James. The Analysis and Adulteration of Foods, Part 1. Tea, Coffee, Cocoa, Sugar, etc. South Kensington Museum Science Hand-Book. London, 1881.

Michigan State Pomological Society. Annual Reports, 1880-1881. Eleven Volumes. Lansing, 1872–1882.

U. S. Department of the Interior. Second Report of the United States' Entomological Commission for the years 1878 and 1879, Relating to the Rocky Mountain Locust and the Western Cricket. Washington, 1880.

U. S. Department of the Interior. United States' Entomological Commission, Bulletin No. 3. The Cotton Worm, by Chas. V. Riley, M. A., Ph. D. Washington, 1881.

U. S. Department of the Interior. Bulletin No. 6. General Index and Supplement to the Nine Reports on the Insects of Missouri, by Chas. V. Riley, M. A., Ph. D. Washington, 1881.

U. S. Department of the Interior. United States' Entomological Commission Bulletin No. 7. Insects Injurious to Forest and Shade Trees, by A. S. Packard, Jr., M. D. Washington, 1881.

U. S. Department of the Interior. United States National Museum. Bulletin of the United States' National Museum, No. 22. Guide to the Flora of Washington and vicinity. Washington, 1881.

Gray, Asa. Field, Forest and Garden Botany. New York, 1880.

Vilmorin–Andrieux & Cie. Les Fleurs De Pleine Terre. Troisienne Edition. Paris.

Bon Jardinier, Le. One Hundred and Twenty-sixth Edition Almanach Horticole, Pour L'annee, 1882. Paris, 1881.

Vilmorin–Andrieux & Cie. Les Meilleurs Bles. Description et Culture des Principales Varieties des Froments. Paris, 1882.

New York Census of 1875. Albany, 1877.

Massachusetts Horticultural Society, Transactions of, for the year 1881. Part 2. Boston, 1882.

New York. Forty-first Annual Report of the New York State Agricultural Society for the year 1881. Albany, 1882.

Martens, Georg von. Die Gartenbohnen. Ihre Verbreitung, Cultur und Benutzung. Ravenburg, 1869.

Frankel, Julius. A Practical Treatise on the Manufacture of Starch Glucose, Starch Sugar and Dextrine, Based on the German of Ladislaus Von Wagner. Philadelphia, 1881.

Tucker, J. H., Ph. D. A Manual on Sugar Analysis. New York, 1881.

Blyth, Alexander Wynter, M. R. C. S., F. C. S., etc. Foods, Their Composition and Analysis. London, 1882.

REPORT OF THE ASSISTANT.

Beans.

The beans under trial comprised forty-six names of dwarf or bush beans, twenty-four names of pole beans, ten Lima beans, the English Windsor bean, the China bean, the Soja bean, and several varieties of the Southern Cow pea. Our remarks, however, are confined to our garden beans.

The Lima beans were planted on June 3, the remainder of the pole beans on June 5, and the bush beans on June 6. The soil was a heavy clay without fertilizer of any kind. The bush beans were planted on soil that had not been plowed since the previous fall, and the soil on which the pole beans were planted was badly infested with quack grass (*Triticum repens*).

The following tables show the date of vegetation, blooming, edible maturity, seed maturity, with the number of days required for each variety, and figures of yields. Those included in braces have been classed as identical in the description following. The numbers refer to the numbers under which the variety is described.

TABLE.

	Variety.	Planted.	Vegetat'd.	Days.	Bloomed.	Days.	Edible.	Days.	Ripe.	Days.
1.	Horticultural,	June 5.	June 15.	10	July 25.	50	Aug. 11.	67	Sept. 19.	106
	Cranberry,	June 5.	June 16.	11	July 25.	50	Aug. 2.	58	Sept. 4.	91
2.	Intermediate Horticultural,	June 6.	June 19.	13	July 18.	42	July 27.	51	Aug. 31.	86
	Dwarf Cranberry,	June 6.	June 16.	10	July 18.	42	July 27.	51	Aug. 26.	81
3.	Concord,	June 5.	June 16.	11	July 20.	45	July 31.	56	Sept. 6.	93
4.	Mottled Cranberry,	June 5.	June 15.	10	July 22.	47	Aug. 4.	60	Sept. 4.	91
5.	Indian Chief,	June 5	June 16.	11	July 25.	50	Aug. 11.	67	Sept. 19.	106
	Black Wax,	June 5.	June 16.	11	....	..	Aug. 24.	80	Oct. 4.	121
	German Wax,	June 5.	June 16.	11	... .	..	Aug. 24.	80	Oct. 11.	128
6.	Red Cranberry,	June 5.	June 15.	10	July 25.	50	Aug. 16.	72	Oct. 4.	121
	Boston Market Pole Cranberry,	June 5.	June 15.	10	July 22.	47	Aug. 4.	60	Sept. 6.	93
7.	Dwarf Red Cranberry,	June 6.	June 16.	10	July 13.	37	July 27.	51	Aug. 26.	81
8.	Pale Dun Runner,	June 5.	June 16.	11	Aug. 7.	63	Aug. 29.	85	Oct. 11.	128
9.	Dun Cranberry,	June 6.	June 16.	10	July 18.	42	July 31.	55	Aug. 31.	86
10.	Golden Cranberry,	June 6.	June 16.	10	July 18.	42	July 31.	55	Aug. 29.	84
11.	White Cranberry,	June 5.	June 16.	11	Aug. 2.	58	Aug. 16.	72	Oct. 4.	121
12.	Turtle Soup,	June 6.	June 16.	10	July 28.	52	Aug. 16.	71	Sept. 6.	92
13.	Newington Wonder,	June 6.	June 16.	10	July 25.	49	Aug. 5.	60	Sept. 4.	90
	Early Snap Shorts,	June 6.	June 15.	9	July 25.	49	Aug. 5.	60	Sept. 6.	92
14.	White Wax,	June 6.	June 16.	10	July 21.	45	Aug. 5.	60	Aug. 31.	86
	White German Wax,	June 6.	June 19.	13	July 22.	46	Aug. 7.	62	Aug. 31.	86
15.	Ivory Pod Wax,	June 6.	June 19.	13	July 21.	45	Aug. 1.	56	Aug. 31.	86
16.	Crystal Wax,	June 6.	June 15.	9	July 25.	49	Aug. 7.	62	Sept. 4.	90
17.	White Algenan Wax,	June 5.	June 15.	10	July 25.	50	Aug. 7.	63	Sept. 13.	100
18.	Mont D'or,	June 5.	June 16.	11	July 22.	47	Aug. 2.	58	Sept. 6.	93
19.	Dwarf Mont D'or,	June 6.	June 16.	10	July 13.	37	July 27.	51	Aug. 29.	84
20.	Dwarf Black Wax,	June 6.	June 16.	10	July 14.	38	July 27.	51	Aug. 29.	84
	Black Wax,	June 6.	June 16.	10	July 14.	38	July 27.	51	Aug. 26.	81
21.	Golden Butter Wax,	June 6.	June 19.	13	July 18.	42	July 25.	49	Aug. 26.	81
22.	Dwarf Golden Wax,	June 6.	June 16.	10	July 13.	37	July 27.	51	Aug. 26.	81
23.	Early China,	June 6.	June 16.	10	July 13.	37	July 27.	51	Aug. 26.	81
24.	True White Pea Bean,	June 6.	June 19.	13	July 25.	49	Aug. 5.	60	Sept. 14.	100
25.	Pea Bean,	June 6.	June 15.	9	July 22.	46	Aug. 5.	60	Sept. 4.	90
26.	White Marrow,	June 6.	June 19.	13	July 18.	42	July 31.	55	Sept. 4.	90
	Marrow,	June 6.	June 16.	10	July 21.	45	July 31.	55	Sept. 4.	90
	Large White Marrow,	June 6.	June 19.	13	July 18.	42	Aug. 1.	56	Sept. 6.	92
	White Corn Hill,	June 6.	June 19.	13	July 26.	49	Aug. 5.	60	Sept. 4.	90

27.	White Scimetar,	June 6.	June 19.	13	July 11.	35	July 27.	51	Aug. 26.	81
28.	Yellow-eyed China,	June 6.	June 19.	13	July 18.	42	July 31.	55	Aug. 29.	84
29.	White Flageolet,	June 6.	June 16.	10	July 18.	37	July 26.	50	Aug. 26.	81
30.	Improved Green Flageolet,	June 6.	June 15.	9	July 18.	42	July 29.	53	Aug. 29.	84
31.	Dwarf German Wax,	June 6.	June 16.	10	July 21.	45	Aug. 2.	57	Aug. 29.	84
32.	Boston Dwarf Wax,	June 6.	June 16.	10	July 18.	42	July 27.	51	Aug. 31.	86
33.	Early Rachel,	June 6.	June 15.	9	July 14.	38	July 26.	50	Aug. 29.	84
34.	Early Mohawk,	June 6.	June 16.	10	July 18.	37	July 26.	50	Aug. 31.	86
35.	French Emile,	June 6.	June 15.	9	July 12.	36	July 26.	50	Aug. 26.	81
36.	Best of All,	June 6.	June 16.	10	July 14.	38	July 29.	53	Aug. 29.	84
37.	Early Feejee,	June 6.	June 15.	9	July 11.	35	July 27.	51	Aug. 29.	84
38.	White Kidney,	June 6.	June 15.	9	July 18.	42	July 29.	53	Sept. 6.	92
39.	Long Yellow Six Weeks,	June 6.	June 16.	10	July 14.	38	July 26.	50	Aug. 29.	84
40.	Dwarf Russian,	June 6.	June 16.	10	July 18.	42	July 29.	53	Sept. 4.	90
41.	Kentucky Wonder,	June 5.	June 15.	10	July 27.	52	Aug. 7.	63	Sept. 13.	100
42.	Early Dun-Colored,	June 6.	June 16.	10	July 14.	38	July 26.	50	Aug. 26.	81
43.	Marblehead Champion,	June 5.	June 16.	11	July 23.	48	Aug. 4.	60	Sept. 4.	91
44.	Refugee,	June 6.	June 16.	10	July 26.	50	Aug. 7.	62	Sept. 14.	100
45.	Gallega,	June 6.	June 16.	10	July 22.	46	Aug. 7.	62	Sept. 14.	100
46.	{ Red Kidney,	June 6.	June 16.	10	July 18.	42	July 31.	55	Aug. 31.	86
	{ Red French Kidney,	June 6.	June 16.	10	July 18.	42	July 31.	55	Aug. 31.	86
47.	{ Canadian Wonder,	June 6.	June 16.	10	July 18.	42	July 29.	53	Aug. 31.	86
	{ Rose,	June 6.	June 19.	13	July 21.	45	July 29.	53	Sept. 4.	90
48.	Red Flageolet,	June 6.	June 16.	10	July 18.	42	July 27.	51	Sept. 4.	90
49.	Purple Flageolet,	June 6.	June 16.	10	July 14.	38	July 25.	49	Aug. 26.	81
50.	Transylvanian Butter,	June 5.	June 16.	11	July 25.	50	Aug. 5.	61	Sept. 6.	93
51.	{ Case Knife,	June 5.	June 16.	11	July 22.	47	Aug. 2.	58	Sept. 4.	91
	{ Dutch Case Knife,	June 5.	June 15.	10	July 25.	50	Aug. 4.	60	Sept. 4.	91
52.	Marshall,	June 5.	June 14.	9	Aug. 5.	61	Aug. 29.	85	Oct. 4.	121
53.	Yellow-Podded White Wax,	June 5.	June 16.	11	July 25.	50	Aug. 7.	63	Sept. 4.	91
54.	{ Giant Red Wax,	June 5.	June 14.	9	....	..	Aug. 24.	80	Oct. 11.	128
	{ Giant Wax,	June 5.	June 15.	10	....	..	Aug. 29.	85	Oct. 11.	128
55.	{ Lima,	June 3.	June 15.	12	Aug. 2.	60	Oct. 4.	123	*Oct. 21.	140
	Large White Lima,	June 3.	June 19.	16	Aug. 5.	63	Oct. 11.	130	*Oct. 21.	140
	Bliss' Early Lima,	June 3.	June 16.	13	July 27.	54	Sept. 19.	108	*Oct. 21.	140
	Dreer's Improved Lima,	June 3.	June 19.	16	July 27.	54	Oct. 4.	123	*Oct. 21.	140
	New Challenger Lima,	June 3.	June 15.	12	Aug. 2.	60	Oct. 4.	123	*Oct. 21.	140
	Small White lima,	June 3.	June 16.	13	July 31.	58	Sept. 19.	108	*Oct. 21.	140
	Red Lima,	June 3.	June 16.	13	July 27.	54	Oct. 4.	123	*Oct. 21.	140
	Speckled Lima,	June 3.	June 16.	13	July 31.	58	Oct. 11.	130	*Oct. 21.	140
56.	Scarlet Runner,	June 5.	June 16.	11	July 14.	39	Aug. 7.	63	Sept. 13.	100
57.	White Runner,	June 5.	June 16.	11	July 18.	43	Aug. 5.	61	Sept. 19.	106
58.	French Yard Long,	June 5.	June 14.	9	Aug. 13.	69	Aug. 24.	80	Sept. 13.	100

* Killed by frost when just beginning to ripen.

VARIETY.	No. seed planted.	No. of plants.	No. of pods.	No. of beans.	Average pods per plant.	Average beans per pl'nt	Average beans per pod.	Weight, grains.	Average weight per pl'nt
1. { Horticultural,	16	12	116	784	9.67	65.33	6.76	554	46.17
{ Cranberry,	16	14	240	1,014	17.14	72.43	4.23	567	40.50
2. { Intermediate Horticultural,	40	33	131	463	3.97	14.03	3.53	232	7.03
{ Dwarf Cranberry,	40	32	128	474	4.00	14.81	3.70	234	7.31
3. Concord,	16	7	154	656	22.00	93.71	4.26	477	68.14
4. Mottled Cranberry,	16	11	50	201	4.55	18.27	4.02	109	9.91
5. { Indian Chief,	16	12	145	657	12.08	54.75	4.53	411	34.25
{ Black Wax,	16	13	97	404	7.46	31.08	4.16	236	18.15
{ German Wax,	16	14	165	715	11.79	51.07	4.33	397	28.36
6. { Red Cranberry,	16	12	121	486	10.08	40.50	4.02	282	23.50
{ Boston Market Pole Cranberry,	16	15	197	801	13.13	53.40	4.07	406	27.07
7. Dwarf Red Cranberry,	40	34	193	732	5.68	21.53	3.79	264	7.76
8. Pale Dun Runner,	16	13	300	1,607	23.08	123.62	5.36	952	73.23
9. Dun Cranberry,	40	34	268	800	7.88	23.53	2.98	352	10.35
10. Golden Cranberry,	40	11	83	306	7.55	27.81	3.69	91	8.27
11. White Cranberry,	16	3	27	108	9.00	36.00	4.00	49	16.33
12. Turtle Soup,	80	62	488	2,289	7.87	36.92	4.69	507	8.18
13. { Newington Wonder,	40	24	248	1,109	10.33	46.20	4.47	218	9.08
{ Early Snap Shorts,	40	34	395	1,864	11.61	54.82	4.72	390	11.47
14. { White Wax,	40	26	185	455	7.12	17.50	2.45	153	5.88
{ White German Wax,	40	18	96	192	5.33	10.67	2.00	66	3.67
15. Ivory Pod Wax,	40	22	130	399	5.91	18.14	3.07	88	4.00
16. Crystal Wax,	40	29	275	863	9.48	29.76	3.14	162	5.58
17. White Algerian Wax,	16	14	201	851	14.36	61.78	4.23	231	16.50
18. Mont D'Or,	16	14	122	581	8.71	41.50	4.76	243	17.36
19. Dwarf Mont D'Or,	40	9	54	197	6.00	21.90	3.65	57	6.33
20. { Dwarf Black Wax,	40	39	223	683	5.72	17.51	3.06	178	4.56
{ Black Wax,	40	30	123	311	4.01	10.37	2.53	83	2.76
21. Golden Butter Wax,	40	30	141	424	4.70	14.13	3.00	144	4.80
22. Dwarf Golden Wax,	40	35	166	548	4.74	15.66	3.30	222	6.34
23. Early China,	40	27	151	393	5.59	14.56	2.60	196	7.26
24. True White Pea Bean,	40	17	81	236	4.76	13.88	2.91	66	3.88
25. Pea Bean,	40	34	443	1,708	13.03	50.23	3.86	334	9.82
26. { White Marrow,	40	36	152	434	4.22	12.06	2.86	228	6.33
{ Marrow,	40	34	177	752	5.21	22.12	4.25	255	7.50
{ Large White Marrow,	40	16	116	341	7.25	21.31	2.94	182	11.38
{ White Corn Hill,	40	33	156	409	4.73	12.39	2.62	204	6.18

27. White Scimetar,	40	18	80	285	4.44	15.83	3.56	106	5.89
28. Yellow Eyed China,	40	30	159	474	5.30	15.80	2.98	298	9.77
29. White Flageolet,	40	32	133	430	4.76	13.44	3.23	120	3.75
30. Improved Green Flageolet,	40	32	230	696	7.19	21.75	3.02	161	5.03
31. Dwarf German Wax,	40	22	109	341	4.95	15.50	3.13	98	4.45
32. Boston Dwarf Wax,	40	22	186	572	8.45	26.00	3.08	164	7.45
33. Early Rachel,	80	65	362	1,399	5.57	21.52	3.86	494	7.60
34. Early Mohawk,	40	37	160	586	4.32	15.84	3.66	236	6.38
35. French Emile,	40	36	151	458	4.19	12.72	3.03	160	4.44
36. Best of All,	40	33	169	589	5.12	17.85	3.49	223	6.76
37. Early Feejee,	40	34	258	928	7.59	27.26	3.60	334	9.82
38. White Kidney.	40	36	271	965	7.53	26.81	3.56	590	16.39
39. Long Yellow Six Weeks,	40	29	134	463	4.62	15.97	3.46	207	7.14
40. Dwarf Russian,	20	18	148	567	8.22	31.50	3.83	252	14.00
41. Kentucky Wonder,	16	13	345	2,418	26.54	186.00	7.01	1,011	77.77
42. Early Dun Colored,	40	36	152	627	4.22	17.42	4.13	266	7.39
43. Marblehead Champion,	16	15	195	1,090	13.00	72.67	5.59	502	33.47
44. Refugee,	40	36	327	1,061	9.08	29.47	3.24	378	10.50
45. Gallega,	40	36	488	1,950	13.55	54.17	4.00	714	19.83
46. { Red Kidney,	40	28	115	366	4.10	13.07	3.18	202	7.21
Red French Kidney,	40	32	227	743	7.09	23.22	3.27	390	12.19
47. { Canadian Wonder,	40	25	160	602	6.40	24.08	3.76	359	14.36
Rose,	40	35	104	380	2.97	10.86	3.65	251	7.17
48. Red Flageolet,	40	32	126	373	3.94	11.66	2.96	195	6.09
49. Purple Flageolet,	40	35	217	581	6.20	16.60	2.68	240	6.86
50. Transglvanian Butter,	16	15	56	171	3.73	11.40	3.05	77	5.13
51. { Case Knife,	16	9	154	665	17.11	73.89	4.32	790	87.77
Dutch Case Knife,	16	13	198	1,014	15.23	78.00	5.17	565	43.46
52. Marshall,	16	13	807	3,784	62.08	291.08	4.69	2,405	185.00
53. Yellow Podded White Wax,	16	5	27	169	5.40	33.80	6.26	63	12.60
54. { Giant Red Wax,	16	16	221	887	13.81	55.44	4.01	357	22.31
Giant Wax,	16	14	292	1,179	20.86	84.21	4.04	455	32.50
55. { Lima,	32	3	39	118	13.00	39.33	3.03	121	40.33
Large White Lima,	32	3	26	45	8.67	15.00	1.85	59	19.67
Bliss' Early Lima,	32	1	54	109	54.00	109.00	2.02	119	119.00
Dreer's Improved Lima,	32	2	26	63	13.00	31.50	2.42	91	45.50
New Challenger Lima,	32	4	110	383	27.50	95.75	3.48	405	101.25
Small White Lima,	32	5	356	766	71.20	153.20	2.15	439	87.80
Red Lima,	32	13	607	920	46.69	70.77	1.52	1,021	78.54
Speckled Lima,	32	2	94	286	47.00	143.00	3.15	229	114.50
56. Scarlet Runner,	16	15	304	829	20.27	55.27	2.73	949	63.27
57. White Runner,	16	11	228	624	20.73	56.73	2.74	766	69.64
58. French Yard Long,	16	10	104	1,135	10.40	113.50	10.91	207	20.70

Since many varieties are used, both as snap or string beans and as shelled beans, as a means of comparison, the garden beans, with the exception of the Limas, Scarlet Runner and Dutch Runner, were classed as snap beans in noting arrival at edible maturity. Vegetation, with the exception of the Limas, was even and good. The Limas required about four more days for vegetation than did the other varieties, and in but one case were more than five plants obtained from the thirty-two seeds planted, while two varieties failed entirely. The weather during this time was wet and very cold.

Of course, with so many varieties, it was difficult to test the eating qualities of all. Some few of the leading varieties were, however, tested and reported upon.

On July 29th the Golden Butter Wax was reported as a tender and sweet snap bean, while on the same date the Purple Flageolet was simply good, somewhat stringy. Two days later the Dwarf Golden Wax was reported tender but not sweet. On August 1st Red Flageolet was reported tender and good, and the Intermediate Horticultural tender and excellent. On August 4th Early Feejee was reported tender and good but not very sweet, and Early China a little tough and of but moderate quality. These were all eaten as snap beans. Of the pole beans the Kentucky Wonder may be mentioned as a remarkably good snap bean ; the pods are long, tender, sweet and excellent and are borne in succession so that they remain fit for the table for quite a period.

Among the more prolific of the bush beans may be mentioned the Canadian Wonder, Dwarf Russian, Newington Wonder, Galega, Dwarf Kidney, Red Kidney, Refugee and Large White Marrow. All of the "Wax" bush beans, as grown by us, were delicate in growth, many even had a diseased appearance, and all were shy bearers. The pods, though tender in all cases tried, were very short and many of them were attacked with rusty brown or black spots, rendering them unfit for the table. Of the pole beans scarcely any made a vigorous growth. Indeed, most of them could almost as well have been grown as bush beans. Even the Limas scarcely attempted to climb the poles furnished them. The only ones that grew at all luxuriantly were Marblehead Champion, Marshall, Pale Dun Runner, Scarlet Runner and White or Dutch Runner. These grew to the top or nearly to the top of the ten-foot poles. Of the bush beans, Purple Flageolet and Golden Butter Wax were the first to arrive at edible maturity, followed one day later by Early Dun Colored, Early Mohawk, Early Rachel, White Flageolet, French Emile and Yellow Six Weeks. Turtle Soup was the latest to become edible. There was a period of twenty-one days between the earliest and the latest.

Of the pole beans Concord was the first to become edible, followed in a few days by Mont D'or, Case Knife, Cranberry, Boston Market, Pole Cranberry, Mottled Cranberry and Marblehead Champion. Marshall, Pale Dun Runner and Giant Wax were the latest of the pole beans. There was a period of thirty days between the earliest and the latest. Bliss' early and Small White were the earliest of the Limas; all the rest were about two weeks later. The English Windsor bean came up, grew vigorously and blossomed, but scarcely any pods were set, and even these ripened no beans. The Soja bean, though planted

late, grew vigorously, blossomed profusely and ripened its seeds, barely escaping frost.

The list of varieties of the bean is so large that one is inclined to say at once that a large number of the names must be synonymous. It was with a view of establishing this synonymy and also to establish if possible some sort of classification of the varieties, that so many were planted.

Nothing has been done in this country, so far as we can learn, toward classifying the different varieties of the garden bean. In Germany a work has been published by Martens,* which classifies the various beans as follows:

1. Phaseolus	vulgaris, Savi,	The common garden bean.
P.	compressus, Martens,	
P.	gonospermus, Savi,	
P.	carinatus, Martens,	
P.	oblongus, Savi,	
P.	ellipticus, Martens,	
P.	sphaericus, Martens,	

2. Phaseolus multiflorus, Lamarck : The Scarlet Runner.
3. Phaseolus lunatus, L.: The Lima bean.

In the above classification the garden beans are separated into species, according to shape, and the minor divisions are mostly founded on difference in color. It is only in separating individual varieties that the important garden division into pole or dwarf beans is used.

The following descriptions of varieties are arranged after a provisional classification. Should the results of another year's trial coincide with the results of this year, the classification and descriptions will be made more definite and complete.

In the descriptions which follow, all numbers referring to size of bean, size of pod, or number of beans in a pod are intended to represent the average of the whole crop, and in no case exceptional developments.

1. Horticultural.

Synonyms, Marbled Prague (Vilm.), London Horticultural, Wrens Egg (Burr), Speckled Cranberry (Martens).

In Martens' work it is classed under *Phaseolus sphaericus haematocarpus*, Savi. Two varieties grown by us from seed obtained from different sources under the names Cranberry and London Horticultural seem to be identical.

The Horticultural is a pole bean, varying, however, very much in height. As grown by us it was scarcely climbing, occasional plants running up four or five feet. According to Burr it grows six feet or more high, and according to Martens, under favorable circumstances, it will grow fifteen feet high. Leaflets broadly oval, moderately short pointed. Flowers white, tinged with pink. Pods, when fully developed, straight or nearly so, much swollen by the beans, greenish yellow abundantly splashed with various shades of crimson and purple. Ripe pods strongly knotted and wrinkled by the beans, parchment

* Die Gartenbohnen. Ihre Verbreitung, Cultur und Benützung, von Georg von Martens, Ravensburg, 1869.

like, slightly flattened or often very nearly round, tipped with a medium slightly bent point. About four and one-half inches long containing four to six beans. Fully developed beans nearly spherical, white splashed with pale rose color. Ripe beans irregularly globose, sometimes slightly oblong, occasionally compressed on the ends, eye usually, slightly protuberant, light brown or dun, variously striped and spotted with dark dull red, the colors becoming darker with age. A dark yellow ring about the eye. The average size of ten seed was 1-2 inch long, 3-8 broad, 5-16 thick.

It was introduced into America from England in 1825. (Burr.)

2. Intermediate Horticultural.

The bean grown by us under the name of Dwarf Cranberry seems to be entirely identical with the Intermediate Horticultural.

A bush bean of medium habit, not much branched, and with no twining habit whatever. As grown by us from ten to twelve inches high. Leaves quite abundant, dark green, somewhat inclined to curliness, leaflets broadly triangular, about two-thirds as wide as long, rarely very slightly heart shaped, slightly taper pointed. Flowers, white tinged with pink. Pods when fully developed more or less sabre form, swollen and knotted by the beans, light yellow or greenish yellow streaked and flushed with crimson or rose color. Ripe pods usually quite strongly bent, slightly flattened or nearly cylindrical, tipped with a slender much curved point, light dun yellow, indistinctly flushed with dull purple, about four and one-half inches long, containing from three to four beans. Fully developed beans white with veiny markings, and with streaks and spots of rose color that are somewhat inclined to be concentric about the eye. Ripe beans slightly oblong or irregularly globose, many are about once and one-half as long as broad, occasionally compressed at the ends, never kidney-shaped, the eye often being slightly protuberant, light brown, streaked and splashed with dull red, and a dark yellow ring about the eye, the colors becoming darker with age. The average size of ten beans was 1-2 inch long, 9-32 broad, 9-32 thick.

The pods and seeds of this bean very closely resemble the preceeding, of which it may be considered a dwarf form. The beans are, however, slightly more oblong, and the pods not quite so wrinkled and knotted as those of the pole Horticultural.

3. Concord.

The Concord is a pole bean growing with us from two and one-half to three feet high, but according to Burr it grows six feet and upward. Foliage rather abundant, leaflets broadly wedge obovate, slightly taper pointed. Flowers white. Pods, when fully developed, sabre-form, swollen by the beans, tipped with a long rather slender point, pale yellow in color; when ripe rather broad, slightly flattened, quite strongly knotted, light brown in color, about four and one-half inches long, containing from four to five beans. Fully developed beans white, with pale rose-colored markings, mostly on the half about the eye. Ripe beans irregularly globose, scarcely oblong, slightly compressed at the ends, eye plane, slightly protuberant. The half of the

bean about the eye light brown or dun, splashed with dull red, the remainder white, with a veiny network, and an occasional small spot of dun or red, a dark yellowish ring about the eye. Ten beans averaged 1-2 inch long, 3-8 inch broad, 5-16 inch thick.

The Concord is mentioned by Burr (1866) as recently introduced. Gregory says its characteristics were made permanent after several years of experimenting, and is doubtless a cross between the White Cranberry and Horticultural, originating in Concord, Mass.

4. Mottled Cranberry.

Syn. Stringless (Burr).

A slightly running, not tall, growing variety. Foliage medium, leafflets broadly ovate, almost triangular, rather short pointed. Flowers white. Pods, when fully developed, more or less sickle-form, not swollen by the beans, tipped with a short, moderately slender, curved point, pale greenish, with a striated appearance as if pubescent; when ripe rather broad, slightly flattened, strongly wrinkled, light dun yellow in color, from four and one-half to five inches long, containing about four beans. Fully developed beans white with the half about the eye red. Ripe beans irregularly globose, more or less oblong, ends occasionally angled by compression, eye plane or often slightly protuberant. The half about the eye and extending over one end a deep dark red in perfect specimens, shading off to a lighter red in those not so perfect, the remainder white with an occasional red spot. The lighter colored beans have a dark ring about the eye. The average of ten beans measured was 1-2 inch long, 5-16 inch broad, 9-32 inch thick.

5. Indian Chief.

Syn. Wax-bean, Butter-bean, Algerian, D'Alger of the French (Burr). Pearl or Round Turkey Pea bean (U. S. Dept. Agr. Rept. 1854), Chinese Butter-bean (Martens), and according to the same authority, in Lyons, Pole Butter-Bean from Algiers; in Paris, Pole Butter-bean, *sans parchemin;* in Lausanne, Yellow podded Italian bean; in Stuttgart, Butter-bean; in Hohenheim, Black Wax pole bean and English Asparagus-bean; in Bopfingen, Citron-bean; in Zurich, Transparent Wax Pole-bean without strings; in Ulm, Wax Pole-bean, etc., etc.

The beans grown by us under the names of Indian Chief, Black Wax and German Wax appear to be identical.

Indian Chief is classed by Martens under *Phaseolus sphaericus niger,* Martens.

The Indian Chief is pole-bean, with us scarcely climbing, although Burr says it grows six or seven feet high. Foliage rather scanty, leaflets quite small (except those grown by us under the name Black Wax); inclined to lozenge shape, moderately taper pointed. Flowers white tinged with pink. Pods yellow from the first, when fully developed, more or less sickle form, much swollen by the beans, tipped with a short stiff curved point, pale yellow, plentifully splashed with purple, ripe pods not materially different except that they are strongly wrinkled; 4 1-2 and 5 1-2 inches long, containing four and five beans.

Fully developed beans white tinged with dark blue. Ripe beans irregularly globose, occasionally flattened sidewise, more or less oblong, black, inclining to purplish, eye usually protuberant. Ten beans averaged in size 1-2 inch long, 3-8 inch broad, 9-32 inch thick.

6. RED CRANBERRY.

Syn. Pearl without strings (U. S. Dept. of Agr. Rept. 1854), Cardinal bean (Martens) and according to the same authority in various places in Germany High violet cardinal bean, Cardinal bean without strings, Medium Imperial Pole-bean, Foul Wife-bean, Red round church or ducat pole bean, etc., etc.

It is classed by Martens under *Phaseolus sphaericus purpureus*, Martens.

The bean grown by us under the name Boston Market Pole Cranberry is apparently identical with the Red Cranberry.

According to Burr the Red Cranberry grows five or six feet high; but with us it was only slightly inclined to run. Foliage only moderately abundant, leaflets large, broadly obovate, almost triangular, moderately taper pointed. Flowers white tinged with pink. Pods when fully developed nearly straight, much swollen by the beans, tipped with a medium stout straight or curved point, pale yellowish, with faint rose-colored plashings. When ripe nearly cylindrical, swollen by the beans, wrinkled, light dun color, about 4 1-2 inches long, containing about four beans. Fully developed beans darker or lighter red, according to stage of development. Ripe beans very nearly globular, the eye usually protuberant, deep dark red. The average size of ten beans was 7-16 inch long, 3-8 inch broad, 5-16 thick.

The Red Cranberry was cultivated in this country in 1828, and is mentioned in the U. S. Patent Office Report for 1854. Burr says that it has probably been longer and more generally cultivated in this country than any other variety.

7. DWARF RED CRANBERRY.

A bush variety of medium height, with no indication of twining, only moderately leafy, leaves rather light and with only a slight inclination to curl, leaflets broadly ovate, taper pointed, occasionally five veined. Flowers pinkish white. Ripe pods rather small, almost straight, slightly knotted, with a straight or curved slender point, medium in length, four to four and one-half inches long, containing about four beans. Ripe beans globular or nearly so, often compressed at the ends, eye usually plane, occasionally protuberant, deep dark red. Average size of ten beans 13-32 inch long, 5-16 inch broad, 1-4 inch thick. The ripe beans of this variety resemble somewhat the pole variety, but may be distinguished by their slightly oblong form and occasionally compressed ends.

It was in cultivation in this country in 1828.

8. PALE DUN RUNNER.

One of the few pole beans that with us grew to any height. Foliage very abundant, leaflets large, broadly ovate, rather inclining to lozenge

shape, moderately taper pointed. Ripe pods straight or nearly so, swollen by the beans, wrinkled, tipped with a slender point of medium length. Pale dun color splashed with pale violet 5 to 5 1-2 inches long, containing about five beans. Ripe beans nearly globular, occasionally compressed at the ends, eye more or less protuberant, light brown or dun with a bright yellow ring about the eye and a peculiar polished shining appearance. Ten beans averaged in size 15-32 inch long, 3-8 inch broad, 5-16 inch thick.

9. Dun Cranberry.

A strictly bush variety. Plant large and vigorous, 12-15 inches high quite bushy, foliage abundant, leaflets small, light colored, but inclined to become curly, the terminal one wedge obovate or slightly heart shaped, the lateral ones similar, but very often irregular from unequal development of the two sides, short petioled, rather inclined to be obtuse. Flowers white tinged with pink. Pods, when fully developed, light greenish yellow, slightly sabre form, swollen by the beans, tipped with a long and slender point; when ripe, more strongly bent, brown, 4 to 4 1-2 inches long, containing about three beans. Fully developed beans pale yellowish white with veiny markings and a slight discoloration about the eye. Ripe beans rather oblong, occasionally compressed on the end, eye plane or slightly protuberant, pale dun, inclining to yellow with a veiny network, a dark brown ring about the eye. Average size of ten beans 1-2 inch long, 5-16 inch broad, 1-4 inch thick.

10. Golden Cranberry.

Syn. Canadian, Round American Kidney (Burr). It is apparently identical with the sulphur-yellow globe bean of Martens, and by him classed under *Phaseolus sphaericus sulfureus,* Martens.

Plant medium in height, about ten inches, sometimes with a distinct climbing habit, then much longer, leaves only moderately dense, with a slight tendency to become curly, leaflets broadly ovate, moderately short-pointed, flowers white, with a slight tinge of pink. Pods, when fully formed, light yellow, straight or nearly so, slightly swollen, tipped with a straight, stiff, quite short point about four inches long containing 3 to 4 beans. Fully developed beans pure white. Ripe beans nearly globular, very slightly oblong, eye plane or slightly protuberant, pale sulphur yellow with veiny markings, a faint pale bluish ring about the eye. Average size of ten beans 11-32 inch long, 9-32 inch broad, 1-4 inch thick. It was apparently in cultivation in this country in 1828.

11. White Cranberry.

Syn. The Sophia bean (Martens) and, according to the same authority in various parts of Europe, Haricot blanc, Haricot sophie, White wax pole bean without strings, Pearl bean, Newest extra wax sugar pole bean with yellow pods, Large field bean, American high wax bean, American white wax pole bean, etc. It is classed by Martens under *Phaseolus sphaericus albus,* Martens.

The White Cranberry, according to Burr, grows five to six feet high, but with us scarcely climbing at all. Only moderately leafy, leaflets of medium size, broadly ovate, rather short-pointed. Flowers white. Pods, when fully developed, straight or nearly so, somewhat swollen by the beans, tipped with a short stout point, pale yellow; when ripe strongly swollen, wrinkled, light dun color, about four inches long, containing about four beans. Fully developed beans white with veiny markings. Ripe beans nearly globular, occasionally slightly compressed at the ends, eye plane or slightly protuberant, pure white, with a faint veiny network and an ivory-like polish. Average size of ten beans 13-32 inch long, 11-32 inch broad, 9-32 inch thick. It was in cultivation in this country in 1828.

12. TURTLE SOUP.

Syn. Tampico (Burr), Negro bean (Martens), and, according to the same authority, in various other places, Frijoles de Tampico, Pois violet, Pois a negres, Black Frijoles, Brazilion running bean, Brazilian dwarf bean, etc. It is classed by Martens under *Phaseolus vulgaris nigerimus*, Zuccagni.

Plant rather slender in habit, with a decided tendency to climbing not much branched, foliage moderately abundant, leaves rather ligh green, no tendency to curliness, leaflets medium size, broadly wedg. obvate, the lateral often unequally developed, very short pointed Flowers purplish. Pods, when fully developed, pale yellow with purple spots, some of them almost entirely dark blackish purple, quite strongly sabre-form, scarcely swollen by the beans, tipped with a short and rather stiff curved point; when ripe dun colored, not swollen or wrinkled, four and one-half to five inches long, containing from four to five beans. Fully developed beans dark purplish black. Ripe beans oblong, kidney-form, flattened sidewise and occasionally compressed at the ends, jet black, shining when first shelled, but losing their lustre when old. Ten beans averaged in size 13-32 inch long, 1-4 inch broad, 5-32 inch thick.

13. NEWINGTON WONDER.

Syn. The Brown date bean (Martens), Early Brown or Liver colt ored bean (Bryant), Tan colored Dwarf bean (Loudon). It is classed by Martens under *Phaseolus oblongus spadiceus*, Savi. The bean grown by us under the name of Early Snap Shorts is apparently identical with this.

A bush bean of quite slender habit, not over ten inches high, but with slender runners much longer, slightly branched, foliage very abundant, rather dark green, not inclined to curl, leaflets very small, broadly ovate, rather short-pointed. Flowers purple. Pods, when fully developed, quite strongly bent, tipped with a short stout straight or curved point, pale yellowish green, often almost entirely covered with reddish purple, about four inches long, containing from four to five beans. Fully developed beans white with veiny markings. Ripe beans oblong, slightly kidney-form, not flattened on the sides, usually compressed on the ends so that they appear quadrangular, light brown or dun color with a veiny network and a yellow ring about the eye, small. Ten beans averaged 3-8 inch long, 1-4 inch broad, 3-16 inch thick.

14. White Wax.

Syn. White German Wax.

A very low bush bean, not over six inches high, stocky, not much branched, entirely without twining habit, leaves not very abundant, medium in color, not inclined to wrinkle, leaflets of medium size, broadly ovate, inclining to lozenge shape, the lateral often unequally developed, moderately taper pointed. Flowers white. Pods when fully developed light yellow, slightly bent, swollen by the beans, tipped with a slender slightly bent point of medium length; when ripe sabre-form, stongly wrinkled, two and three-quarters to three and one-half inches long, containing two to three beans. Fully developed beans white with veiny markings. Ripe beans irregularly globular or slightly oblong, usually flattened sidewise, eye plane or slightly protuberant, pure white. Average size of ten beans, 7-16 inch long, 5-16 inch broad, 1-4 inch thick.

15. Ivory Pod Wax.

A bush bean of slender growth, not much branched, about eight inches high, foliage not abundant, leaflets of medium size, broadly ovate, inclined to lozenge shape, taper pointed. Fowers white. Pods, when fully developed, white, slightly tinged with yellow, sabre-form, greatly swollen by the beans, tipped with a long and slender curved point. When ripe slender, strongly sabre-form, slightly wrinkled, not much swollen, about 3 1-2 inches long, containing about three beans. Fully developed beans white with veiny markings. Ripe beans oblong, occasionally slightly kidney form, slightly flattened sidewise, occasionally compressed at the ends, pure white. Average size of ten seed 13-32 inch long, 9-32 inch broad, 7-32 inch thick. According to Ferry this bean is of recent introduction.

16. Crystal Wax.

A bush bean of slender habit, quite strongly branched, no indication of runners, not very tall, but inclined to be prostrate, foliage very abundant, leaves rather light green, not inclined to curl, leaflets very small, broadly ovate, the lateral often unequally developed, short pointed. Flowers white. Pods at first a peculiar translucent greenish pearl color; when fully developed, pale yellowish green deeply flushed with purple, quite strongly bent, much swollen by the beans, tipped with a slender point of medium length; when ripe, pale dun, slightly wrinkled, 3 1-2 to 4 inches long, containing about three beans. Fully developed beans white with veiny markings. Ripe beans oblong, more or less kidney-form, slightly flattened sidewise, pure white. Average size of ten beans. 13-32 inch long, 7-32 inch broad, 3-16 inch thick. It is chiefly distinguished from the preceding by the peculiar color of the young pods and the smaller more kidney-form beans.

17. White Algerian Wax.

A pole bean, with us scarcely climbing. Foliage rather scanty, leaflets broadly ovate, short pointed. Flowers white. Pods, when fully developed, yellow; when ripe, strongly bent, wrinkled, not much swollen by the beans, light dun yellow, tipped with a long slender

point, about 4 1-2 inches long, containing from four to five beans. Ripe beans, oblong, more or less kidney-form, slightly flattened sidewise, ends often slightly compressed, pure white, with an indistinct veiny network and an ivory polished appearance. Average size of ten beans 13-32 inch long, 1-4 inch wide, 7-32 inch thick.

18. MONT D'OR.

Syn. Golden Butter (Bliss), Butter or Wax (Vilmorin).

Although advertised as a pole bean, as grown by us it could as well be grown as a bush bean without poles. Foliage abundant, leaflets of medium size, broadly obovate or almost triangular, taper pointed. Flowers purplish. Pods when fully developed, bright yellow with occasional purple splashes, more or less sickle form, somewhat swollen by the beans, tipped with a moderately short, stout, slightly curved point; when ripe, scarcely swollen, slightly wrinkled, almost cylinrical, light dun yellow, about five inches long, containing from four to five beans. Fully developed beans, dark reddish purple with veiny markings. Ripe beans, oblong, not kidney form, the eye often protuberant, very slightly flattened on the sides, rarely compressed at the ends, dark brown indistinctly mottled with dull purple. Average size of ten beans, 1-2 inch long, 11-32 inch broad, 9-32 inch thick.

19. DWARF MONT D'OR.

A bush bean growing not over twelve inches high with no twining habit at all. Foliage quite abundant, somewhat inclined to a wrinkled curly appearance, leaflets broadly ovate, taper pointed. Flowers purplish. Pods, when fully developed, pale cream color, obscurely flecked with purple, slightly sickle form, somewhat swollen by the beans, tipped with a straight point; when ripe quite strongly bent, slightly wrinkled, dun color, 3 1-2 to 4 1-2 inches long, containing from three to four beans. Fully developed beans dark reddish purple; ripe beans oblong, not kidney-form, very slightly flattened at the sides, not compressed on the ends, jet black. Average size of ten beans 13-32 inch long, 9-32 inch broad, 1-4 inch thick.

20. DWARF BLACK WAX.

Syn. Black Wax, Butter (Harris).

A very low bush bean, about eight inches high, not much branched, very leafy, no indication of runners. Leaves dark green, quite inclined to curliness, leaflets rather small, broadly ovate, short pointed, the lateral often irregularly developed. Flowers purplish. Pods when fully developed, bright waxy yellow, quite strongly sabre-form, tipped with a curved rather slender point of medium length; when ripe, much shrunken, inclosing the beans very tightly, wrinkled, dark dun yellow, 3-4 inch long, containing two to three beans. Beans oblong, very slightly, kidney-form, scarcely flattened sidewise, not compressed on the ends, jet black. The average size of ten beans measured was 7-16 inch long, 1-4 inch broad, 1-4 inch thick. These beans may be distinguished from the preceding by their greater proportionate length and by not having the pods flecked with purple.

21. Golden Butter Wax.

A low bush bean with no twining habit, slightly branched, foliage not very abundant, leaflets medium size, broadly ovate inclining to triangular, taper pointed. Flowers purplish. Pods, when fully developed, slightly bent, pale yellow, slightly transparent so that the black color of the beans is manifest; when ripe much shrunken and wrinkled, adhering closely to the beans, dark dun yellow, 3 1-2 to 4 1-2 inches long, containing about three beans. Beans oblong, kidney-form, almost cylindrical, occasionally slightly compressed at the ends, jet black, shining. Average size of ten beans 1-2 inch long, 1-4 inch wide, 7-32 inch thick. These may be distinguished from the two preceding by the kidney shape and by their still greater proportionate length.

22. Dwarf Golden Wax.

Syn. York Dwarf Wax (Gregory).

A bush bean of rather stocky habit and no indication of runners, not much branched, foliage not very abundant. Leaves dark green, quite curly, leaflets rather large, broadly ovate, rather short pointed. Flowers creamy white. Pods, when fully developed, light yellow with purple markings, slightly bent, swollen by the beans, tipped with a short and slender straight or curved point, when ripe slightly wrinkled, dark dun yellow, 3 3-4 to 4 1-2 inches long, containing three to four beans. Fully developed beans pale rose color with white streaks and spots. Ripe beans oblong, not compressed at the ends, very slightly flattened sidewise, eye plane or very slightly sunken, the half about the eye mottled with dull purple, the rest white. Average size of ten beans 15-32 inch long, 9-32 inch broad, 1-4 inch thick. These beans are said to have been introduced into this country by Gregory in 1871 under the name of York Dwarf Wax.

23. Early China.

Syn. China, Red-eyed China (Burr), Red Eye (Gregory), China Red Eye (Landreth), Early China Red Eye (Ferry), Chinese Date Bean (Martens), Fagiuoli nani della China (Savi before 1822). According to Martens they are called by the following names in various places: In the Island Bourbon, Haricot Marbre; in Canada, Dwarf Early Canada; in Turin, Venice, Paris, Lausanne and Stuttgart, Sugar-asparagus-bush bean; in Bopnfigen Cuckoo bean; in Bamberg, Red Speckled Spring bean; in Lubbenau, Red Speckled bush bean; in Dresden and Göttingen, Early English Dwarf bean; and in Christiana, Early Eagle bush bean, Haricot Chimois and China Dwarf-bean. It is classed by Martens under *Phaseolus oblongus alboruber*, Savi.

The Early China is a vigorous, not twining, moderately branched bush bean, with abundant foliage. Leaves dark green, somewhat curly, leaflets of medium size, broadly ovate, taper pointed. Flowers white. Pods, when fully developed, light greenish yellow, straight or nearly so, not much swollen by the beans, tipped with a long, moderately stiff straight point; when ripe slightly bent, scarcely swollen by the beans, parchment like, light dun color, four and five inches long, containing from two to three beans. Fully developed beans white with veiny

markings, the half about the eye covered with pink splashings. Ripe beans oblong, very slightly flattened sidewise, slightly compressed on the ends, eye plane or very slightly sunken; white, with a large spot around the eye, dark red mottled with light brown or dun color. Average size of ten beans 15-32 inch long, 5-16 inch broad, 9-32 inch thick.

According to Martens this bean was described by Savi in Italy previous to 1822. It was cultivated in this country in 1828 and is mentioned by Browne (U. S. Patent Office Report) in 1854.

We are unaware that any analysis of the string bean in edible condition has heretofore been made; we therefore append one of this variety made by Dr. S. M. Babcock, chemist to the Station:

August 9, 1882. String beans of the Early China variety in edible condition, pod and bean.

	Fresh Bean.	Dry substance.
Water	83·46	.. ..
Ash	·81	5·01
Nitrogen 0·44, 2·64 (Equivalent to Albumenoids)	2·75	16·50
Fat (Ether Extract)	·34	2·05
Crude Fiber	2·58	15·60
Carbohydrates, by difference	10·04	60·84
	100·00	100·00

24. TRUE WHITE PEA BEAN.

A rather slender bush bean, with a distinct twining habit, rising about ten inches high, but inclined to fall over and run along the ground, quite strongly branched. Leaves abundant, of medium color, not inclined to curl. Leaflets rather small, broadly wedge obovate, taper pointed. Flowers white. Pods, when fully developed, light greenish yellow, straight, or nearly so, swollen by the beans, tipped with a rather stout, curved point, of medium length; when ripe, dun color, parchment-like, not swollen by the beans, 2 3-4 to 3 3-4 inches long, containing about three beans. Fully developed bean white, with veiny markings. Ripe beans globular, or nearly so, showing a great tendency to split open on the back while ripening; white, with an indistinct, veiny network. Ten beans averaged in size 5-16 inch long, 9-32 inch broad, 1-4 inch thick.

25. PEA-BEAN.

Syn. Navy. Burr gives the preference to Pea-Bean, which we have followed, though it would be better to adopt the name Navy as distinguishing it from the preceding.

A bush bean of rather slender habit, though not at all twining; much branched. Foliage abundant. Leaves rather light green, not at all inclined to be curly. Leaflets for the most part rather small, but with occasional ones of larger size, broadly wedge obovate, rather short-pointed. Flowers white. Pods, when fully developed, light yellow; straight, or nearly so; tipped with a slender, straight or curved

point; when ripe, slightly swollen by the beans, rather flat, dun color, 3 1-2 to 4 inches long, containing three to four beans. Fully developed beans white, with veiny markings. Ripe beans oblong, not kidney-form, slightly flattened sidewise, not compressed at the ends; white, with an indistinct, veiny network. Average size of ten beans 11-32 inch long, 1-4 inch broad, 3-16 inch thick. The ripe beans of this variety are very easily distinguished from the preceding by their smaller size and oblong shape.

26. White Marrow.

Syn. White Marrowfat, Dwarf White Cranberry, White Egg (Burr), Large White Marrow, Mountain, Marrow, White Corn Hill.

It was grown by us under the names White Corn Hill, Marrow, White Marrow, and Large White Marrow or Mountain; and these proved to be apparently identical.

A bush bean of rather slender habit, and a distinct tendency to twining. Not very much branched. Foliage not very abundant, not curly, medium in color. Leaflets rather large, broadly wedge-shaped, the lateral often unequally developed, rather taper-pointed. Flowers white. Pods, when fully developed, pale greenish yellow, straight or slightly bent, swollen by the beans, tipped with a slender point of medium length; when ripe, more or less bent, slightly flattened, much swollen by the beans, dun color, 3 3-4 to 4 3-4 inches long, containing two to three beans. Fully developed beans white, with veiny markings. Ripe beans oblong, rarely slightly kidney form, and flattened sidewise, not compressed on the ends, having a great tendency to split open on the back while ripening; white, with a veiny network. Average size of ten beans 1-2 inch long, 5-16 inch broad, 9-32 inch thick.

It was in cultivation in this country in 1828.

27. White Scimetar.

A bush bean of ordinary habit, not twining, about ten inches high. Leaves rather dark green, not inclined to wrinkle. Leaflets of medium size, broadly wedge-shaped, occasionally heart-sharped, rather short-pointed. Flowers white. Pods, when fully developed, light greenish yellow, straight, or nearly so, swollen by the beans, tipped with a slender, curved point of medium length; when ripe, somewhat flattened, slightly swollen, parchment-like, dun color, about 5 1-2 inches long, containing three to four beans. Fully developed beans white, with veiny markings. Ripe beans oblong, kidney-form, quite strongly flattened sidewise, slightly compressed at the ends, white, with a veiny network, and ivory, polished appearance. Ten beans averaged in size 17-32 inch long, 5-16 inch broad, 1-4 inch thick. The ripe beans may be distinguished from the preceding by their greater flatness and polished appearance.

28. Yellow-Eyed China.

Syn. Improved Yellow Eye (Gregory).

A vigorous bush bean, not twining or much branched, about sixteen

inches high. Foliage abundant, of medium color, not inclined to become wrinkled. Leaflets rather large, broadly obovate, the lateral often irregularly developed, short-pointed. Flowers white. Pods, when fully developed, pale greenish yellow, straight, or nearly so, slightly swollen by the beans, tipped with a straight, stiff point; when ripe, nearly cylindrical, considerably swollen by the beans, light dun yellow, about 4 1-2 inches long, containing about three beans. Fully developed beans white, with veiny markings and a purple ring around the eye. Ripe beans oblong, occasionally slightly kidney-form, slightly flattened sidewise, not compressed on the ends, white, with the half about the eye yellowish brown. Average size of ten beans 17-32 inch long, 11-32 inch broad, 5-16 inch thick.

29. WHITE FLAGEOLET.

A vigorous bush bean, with no tendency to twining, ten to twelve inches high, moderately branched, quite leafy. Leaves dark green, quite curly. Leaflets rather small, broadly ovate, often slightly heart-shaped, short-pointed, rather thin and papery. Flowers white. Pods, when fully developed, light green, somewhat curved, with a long and slender, straight or curved point; when ripe, very slightly swollen, almost cylindrical, parchment-like, tan colored, from 4 to 4 1-2 inches long, containing about three beans. Fully developed beans white, with veiny markings. Ripe beans oblong, kidney-form, flattened sidewise, not compressed at the ends, white, with a veiny network, and a polished, ivory-like appearance. Ten beans averaged in size 15-32 inch long, 1-4 inch broad, 3-16 inch thick.

30. IMPROVED GREEN FLAGEOLET.

A bush bean, with no appearance of runners, quite strongly branched, twelve to fifteen inches high. Foliage abundant, rather dark green. Leaflets medium size, broadly wedge obovate, inclining to triangular, rather taper pointed. Flowers white. Pods, when fully developed, dark green, quite strongly bent, not swollen or turgid, tipped with a long, slender point; when ripe nearly cylindrical, slightly swollen, parchment like, tan color. About four and one-half inches long, containing about three beans. Fully developed beans light pea green. Ripe beans oblong, quite strongly kidney-form, flattened sidewise, not compressed at the ends, white or occasionally greenish with a veiny network and a polished ivory-like appearance. Average size of ten beans 15-32 inch long, 1-4 inch broad, 3-16 inch thick. The green color of the ripe beans is the main point of distinction between this and the preceding, but in our own case this color nearly disappeared in one season's growing. It seems more than probable, therefore, that this variety is as yet an unestablished form of the preceding.

31. DWARF GERMAN WAX.

A rather stout bush, bean with no tendency to twining, about eight inches high, moderately branched. Foliage abundant, dark green, quite curly. Leaflets broadly ovate inclining to triangular, taper pointed.

Flowers white. Pods, when fully developed, clear waxy yellow, somewhat sabre-form, much swollen by the beans, tipped with a short curved point; when ripe somewhat wrinkled, tan colored, 3 1-2 to 4 1-2 inches long, containing about three beans. Fully developed beans white with veiny markings. Ripe beans oblong, kidney-form, slightly flattened at the sides, usually slightly compressed at the ends, white with a veiny network. Average size of ten beans 17-32 inch long, 1-4 inch broad, 3-16 inch thick. It is to be distinguished from No 14 by the oblong shape of the ripe beans.

32. Boston Dwarf Wax.

A low bush bean with no twining habit, not much branched nor very leafy, leaflets of medium size, broadly ovate, inclining to lozenge shape, taper pointed. Flowers white, slightly tinged with pink. Pods when fully developed yellow, when ripe much contracted, enclosing the seeds very tightly, dark dun color, from three to four inches lobg, containing about three beans. Ripe beans varying from dark dun to dark brown, with a black ring about the eye, oblong, slightly kidney form, slightly flattened sidewise, rarely slightly compressed at the ends. Average size of ten beans 15-32 inches long, 1-4 inch broad, 1-4 inch thick.

33. Early Rachel.

Syn. The Rachel bean (Martens).

According to the same authority they are known in Canada as Early Rachel or Quail-head beans. They are classed by Martens under *Phaseolus oblongus Rachelianus*, Martens.

A bush bean, of medium habit, entirely without runners or tendrils, quite tall, about fifteen inches, moderately branched. Foliage not very abundant, dark green, not curly. Leaflets quite large, obovate, often slightly heart-shaped, rather short pointed. Flowers very nearly pure white, a slight tinge of pink. Pods, when fully developed, green, straight or nearly so, quite strongly swollen by the beans, tipped with a medium straight or curved point; when ripe, slightly curved, light dun yellow, about five inches long, containing from three to four beans. Fully developed beans muddy dun color, with a purple ring about the eye. Ripe beans oblong, kidney-form, slightly flattened sidewise, not compressed on the ends, dark brown, white on one end, and a dark line about the eye. In every case noticed the white end of the bean was turned toward the point of the pod. The seed planted by us had an occasional bean without any white color, and of the beans raised from this seed about two-thirds had no white ends. Average size of ten beans 17-32 inch long, 9-32 inch broad, 1-4 inch thick.

34. Early Mohawk.

Syn. Early Brown Six Weeks (Landreth), Purple Speckled Date bean (Martens).

According to the same authority they are known by the following names in various places: Long Red Speckled kidney bean in Canada, Fagiolo Americano in France, Fagiolo di Montagna in Italy, Early Dwarf bean, Variegated Strawberry bean, Red Speckled Lady

bean, Earliest Red Speckled Brazilian Dwarf bean, etc., in Germany. It is classed by Martens under *Phaseolus oblongus purpurcovariegatus*, Martens.

A rather stout bush bean, with no tendrils, about twelve inches in height, quite bushy. Foliage not very abundant, dark green, somewhat curly. Leaflets large, broadly wedge obovate, taper pointed. Flowers white, slightly tinged with pink. Pods, when fully developed, light green, almost straight, slightly swollen by the beans, tipped with a long straight or curved point; when ripe, slightly bent, almost cylindrical, light dun yellow, 4 3-4 to 5 1-4 inches long, containing about four beans. Ripe beans oblong, usually slightly kidney-form, almost cylindrical, occasionally slightly compressed at the ends, dull reddish purple streaked and mottled with light brown. Average size of ten beans 19-32 inch long, 9-32 inch broad, 1-4 inch thick.

It was in cultivation in this country in 1828, and we may suspect is one of the native beans of this country.

35. FRENCH EMILE.

A low, stocky bush bean, without tendrils or twining habit, eight to ten inches high, little branched. Foliage abundant, rather dark-green, somewhat curly. Leaflets of medium size, broadly obovate, taper pointed, rarely slightly heart-shaped. Flowers white, with a very slight tinge of pink. Fully developed pods green, somewhat sabre-form, tipped with a slender straight or curved point; three and three-fourths to four and one-half inches long, containing about three beans; ripe beans oblong, occasionally slightly kidney form, almost cylindrical, rarely slightly compressed at the ends, dark chocolate purple mottled with light brown. Average size of ten beans, 12-32 inch long, 9-32 inch broad, 1-4 inch thick. The ripe beans resemble somewhat those of the Early Mohawk, but may easily be distinguished by their shorter proportionate length and general lighter appearance.

36. BEST OF ALL.

A bushy bean of medium size, with no twining habit, about twelve inches high. Leaflets large, obovate, taper pointed. Flowers pinkish white. Pods green when young; when fully developed yellow, more or less blotched with rose-color, smooth, almost straight, much swollen by the beans, tipped with a blunt curved point; when ripe not very much swollen, slightly wrinkled, almost cylindrical, pale dun yellow, five to five and one-half inches long, containing from three to four beans. Fully developed beans white mottled with pale rose-color. Ripe beans oblong, very slightly kidney-form, somewhat flattened sidewise, rarely slightly compressed on the ends, light brown, mottled and streaked with dull red, a yellow ring about the eye. Average size of ten beans 1-2 inch long, 9-32 inch broad, 1-4 inch thick.

The color of these beans is very similar to Horticultural and Intermediate Horticultural, but they may be easily distinguished by the oblong, slightly flattened form of Best of All.

37. Early Feejee.

Syn. White's Early (Burr).

A bush bean, of medium habit, about twelve inches high, but sending out long runners like a pole bean. Foliage quite thick, light green, not curly, stems and petioles with dark purplish lines. Leaflets quite small, broadly wedge obovate, the lateral often irregular from unequal development of the upper side, short pointed. Flowers white, striped with purple. Pods, when fully developed, dark green, splashed with dark purple, especially on the sunny side, quite strongly curved, much swollen by the beans, tipped with a short, stout curved point; when ripe flattened, parchment-like, dun color, four and one-half to five and one-half inches long, containing from three to four beans. Fully developed beans white, with veiny markings. Ripe beans oblong, quite strongly kidney-form, flattened sidewise, rarely compressed at the ends, varying from almost pure white to white mottled and streaked with various shades of dull blue and drab. Average size of ten beans 17-32 inch long, 5-16 inch broad, 7-32 inch thick.

38. White Kidney.

Syn. Kidney, Large White Kidney, Royal Dwarf, the White Date Bean (Martens).

According to the same authority it is called by the following names in various places: in Canada, Imperial Dwarf Kidney, and Dwarf Long Dutch White; in Spain, Judias blancas; in Naples, Fagioli a cannellini; in Venice, Fasoloni bianchi; in France, Rognon de coq, and Haricot suisse blanc nain; in Germany, Early White Club bean, White Cylindrical Dwarf bean, Long-podded White Dwarf Kidney bean, etc., etc. It is classed by Martens under *Phaseolus oblongus albus*, Martens.

A rather stocky bush bean without twining habit. Leaves rather light green with no tendency to curl. Leaflets rather large, wedge obovate inclined to diamond shape, rather taper pointed. Flowers white. Pods, when fully developed, straight or nearly so, light yellow, tipped with a long slender straight point; when ripe nearly cylindrical, slightly swollen, parchment-like, pale dun yellow, about six inches long, containing three to four beans. Fully developed beans white, with veiny markings. Average size of ten beans 5-8 inch long, 5-16 inch broad, 1-4 inch thick. It was in cultivation in this country in 1828.

39. Long Yellow Six Weeks.

Syn. Six Weeks, Yellow Six Weeks (Burr), the Gold bean (Martens).

According to Martens it is known in Canada as Montreal Bean; in Italy as Fagiolo della regina; in France as Haricots ronds printaniers; in Germany as Early Yellow Princess Dwarf bean, Yellow Egg bean, etc. It is classed by Martens under *Phaseolus ellipticus aureus*, Zuccagni.

A vigorous bush bean, with no tendency to twining, quite well branched. Foliage very abundant, dark green, slightly inclined to curl. Leaflets rather large, broadly ovate, sometimes heart shaped, quite short pointed. Flowers white, tinged with pink. Pods, when fully developed, light yellowish green, slightly sabre-form, scarcely swollen by the

beans, tipped with a long slender straight point; when ripe more bent, almost cylindrical, parchment like, dun color, from four to six inches long, containing from three to four beans. Fully developed beans greenish white with veiny markings; ripe beans oblong, kidney-form, scarcely flattened sidewise, rarely compressed on the ends, varying from yellowish brown when first shelled to light brown when older, with a dark ring about the eye. Average size of ten beans 19-32 inch long, 9-32 inch broad, 1-4 inch thick.

It was in cultivation in this country in 1828.

40. DWARF RUSSIAN.

A bush bean of medium habit with no indication of runners, twelve to sixteen inches high, moderately branched. Foliage quite abundant, rather dark green, slightly inclined to become curly. Leaflets of medium size, broadly obovate, taper pointed, especially the terminal one. Flowers purplish. Pods, when fully developed, pale yellow splashed with purple, especially near the end and along the dorsal and ventral sutures, straight or nearly so, not markedly swollen by the beans, tipped with a medium slender point, the beans placed rather widely apart; when ripe nearly cylindrical, parchment like, pale dun color, about six inches long, containing about four beans. Fully developed beans white with veiny markings. Ripe beans oblong, scarcely kidney-form, slightly flattened sidewise, not compressed at the ends, light dun color with a darker ring about the eye and a peculiar rough feeling when handled. According to Gregory this is a new bean lately sent out by Vilmorin & Cie, of Paris.

41. KENTUCKY WONDER.

A pole bean, with us scarcely running, though occasional plants run up four or five feet. Foliage moderately abundant. Leaflets broadly oval, rather taper-pointed. Flowers white. Pods, when ripe, straight or curved, much swollen by the beans, wrinkled, almost cylindrical, about seven inches long, containing about seven beans. Ripe beans oblong, occasionally slightly kidney-form, slightly flattened sidewise, rarely compressed on the ends, dark brownish drab with veiny markings. A yellowish red ring about the eye, and a polished appearance. Average size of ten beans 18-32 inch long, 9-32 inch broad, 7-32 inch thick.

42. EARLY DUN COLORED.

A bush bean, of medium habit and no indication of tendrils, ten to fifteen inches high, moderately branched. Foliage abundant, rather curly. Leaflets rather large, broadly obovate, the lateral often irregularly developed, taper pointed. Flowers white, slightly tinged with pink. Pods, when fully developed, pale green with a peculiar striated hairy appearance, though perfectly smooth, straight, or nearly so, very slightly swollen by the beans, tipped with a long curved point; when ripe cylindrical, parchment like, light dun color, from four to five inches long, containing about four beans. Fully developed beans a peculiar slate drab or dun color with a purple ring about the eye. Ripe beans oblong, usually slightly kidney-form, nearly cylindrical,

frequently compressed on the ends, dark dun brown with an almost black ring about the eye. Average size of ten beans 9-16 inch long, 1-4 inch broad, 1-4 inch thick.

According to Burr this variety has been cultivated for a long time in England and other parts of Europe. It was cultivated in this country in 1828.

43. Marblehead Champion.

One of the few pole beans that grew to any size, seven to nine feet high, rather slender. Foliage not very abundant. Leaflets broadly oval, rather stout pointed. Flowers purple. Ripe pods strongly curved, not much swollen by the beans, wrinkled, tipped with a rather short point, pale dun yellow, five and three-fourths to six and one-fourth inches long, containing five to six beans. Ripe beans oblong, slightly kidney-form, more or less flattened sidewise, frequently compressed at one end, rarely at both, light brown or dun, finely mottled with chocolate. Average size of ten beans 19-32 inch long, 9-32 inch broad, 1-4 inch thick.

44. Refugee.

Syn. One Thousand to One (Burr), Brown Speckled Valentine (Landreth), Turkish Date Bean (Martens), and according to the same authority it is called by the Missouri Indians Ohmenik pusaebne; on the Bourbon Island, Haricot lilas vert; in Algiers, Haricot noir and Haricot de Bagnols; in Lisbon, Haricot bleu; in Venice, Fasioi faraoni; in Lausanne and Paris, Haricot suisse gris and Haricot gris de Bagnols; in Germany, variegated Dutch and American Dwarf bean, Black Speckled Lady bean, Blue Dwarf bean, etc., etc. It is classed by Martens under *Phaseolus oblongus turcicus*, Savi.

A bush bean, of medium habit, not much branched and with no tendency to twining, eight to ten inches high. Foliage quite abundant, rather light green, not curly. Leaflets small, broadly ovate inclined to diamond-shaped, taper pointed. Flowers purplish. Pods, when fully developed, light yellow, sparingly spotted and splashed with dark purple, sabre-form, slightly swollen by the beans, tipped with a long, strongly bent, stout point; when ripe cylindrical, parchment-like, dun color, four and three-fourths to five and one-fourth inches long, containing from three to four beans. Fully developed beans white nearly covered with lilac splashings. Ripe beans oblong, slightly kidney-form, almost cylindrical, rarely compressed at the ends, dark reddish purple splashed and mottled with light brown or dun color. Average size of ten beans 17-32 inch long, 1-4 inch broad, 7-32 inch thick.

It was cultivated in this country in 1828.

45. Galega.

Syn. Large Refugee (Henderson).

A rather slender but very luxuriant bush bean, with no twining habit. Leaves rather light green, not wrinkled. Leaflets of medium size, broadly wedge obovate, often rather diamond-shape, very taper

pointed. Flowers purplish. Pods when fully developed pale greenish yellow, abundantly striped and splashed with purple, straight or slightly sabre-form, tipped with a short, blunt almost straight point; when ripe scarcely swollen by the beans, almost cylindrical, parchment like, light dun yellow, five to six inches long, containing about four beans. Fully developed beans dark purple with abundant white spots. Ripe beans oblong, kidney-form, nearly cylindrical, rarely compressed at the ends, purplish black splashed and mottled with light brown or dun color. Average size of ten beans 9-16 inch long, 1-4 inch broad, 7-32 inch thick.

This bean resembles in many respects the Refugee, from which it is said to have been derived. It may be readily distinguished from it by the slightly larger size and general darker appearance of the ripe beans.

46. RED KIDNEY.

Syn. Red French Kidney (Ferry), Chilian (Burr).

A bush bean, of ordinary habit, not much branched and with no tendency to twining, 12 to 14 inches high. Foliage not very abundant, of medium color, not curly. Leaflets rather large, broadly wedge obovate, medium pointed. Flowers white with a slight tinge of pink. Pods, when fully developed, light greenish yellow, straight or nearly so, tipped with a slender point of medium length; when ripe slightly swollen by the beans, somewhat flattened, slightly wrinkled, parchment like, light dun yellow, five to five and a half inches long, containing about three beans. Fully developed beans light rose color. Ripe beans oblong, kidney-form, flattened sidewise, frequently compressed on the ends, light red changing to light brown. Average size of ten beans 21-32 inch long, 5-16 inch broad, 1-4 inch thick.

47. CANADIAN WONDER.

Syn. Rose (Gregory).

The Rose, although advertised as a new bean is apparently identical with the Canadian Wonder.

A rather stout bush bean, with no twining habit, about eighteen inches high, not very much branched. Foliage abundant, rather dark, slightly curly. Leaflets large, broadly wedge shape, inclining to triangular, the lateral sometimes irregularly developed, rather short pointed. Flowers white tinged with pink. Pods, when fully developed, pale yellow, almost straight, not much swollen by the beans, tipped with a long curved point; when ripe nearly cylindrical, parchment like, light dun color, five and three-fourths to six and three-fourths inches long, containing from three to four beans. Fully developed beans bright rose color. Ripe beans oblong, quite strongly kidney-form, flattened sidewise, unusually strongly compressed on the ends, very dark red. Average size of ten beans 11-16 inch long, 11-32 inch broad, 1-4 inch thick.

48. RED FLAGEOLET.

A medium growing bush bean, with no twining habit, twelve to fourteen inches high, quite strongly branched. Foliage abundant, rather light green, not wrinkled. Leaflets medium in size, broadly obovate

taper pointed. Flowers pinkish white. Pods, when fully developed yellow, straight or nearly so, tipped with a long slender point; when ripe swollen by the beans, not flattened, parchment like, dun color, six to six and a half inches long, containing about three beans. Fully developed beans white with a tinge of red. Ripe beans oblong, slightly kidney-form, slightly flattened sidewise, unusually more or less compressed on the ends, dark red shading almost to black. Average size of ten beans 5-8 inch long, 5-16 inch broad, 1-4 inch thick.

49. Purple Flageolet.

A strongly branched leafy bush bean, without twining habit, twelve to fifteen inches high. Leaflets rather small, obovate, inclining to lozenge shape, taper pointed. Flowers purple. Pods when fully developed, dark green, very broad, straight or slightly bent, tipped with a long slender point; when ripe, slightly swollen by the beans, almost cylindrical, dun color, 4 3-4 to 5 1-4 inches long, containing from two to three beans. Ripe beans oblong, slightly kidney-form, flattened sidewise, rarely compressed at the ends, dull dark purple, almost black. Average size of ten beans, 9-16 inch long, 9-32 inch broad, 7-32 inch thick. They are easily distinguished from the preceding by the green color of the pods and the purple color of the beans.

50. Transylvanian Butter.

A pole bean, with us scarcely climbing, not more than one foot high. Foliage quite abundant, dark green. Leaflets small, obovate inclining to triangular, short pointed. Flowers purplish. Pods, when fully developed, very broad, dark green, almost entirely covered with purple stripes; when ripe, much swollen by the beans, straight or nearly so, wrinkled, parchment like, dun color with dark purple stripes, 3 1-2 to 4 inches long, containing about three beans. Ripe beans, lenticular, pale dirty blue shading off into bluish dun color. Average size of ten beans, 1-2 inch long, 3-8 inch broad, 9-32 inch thick.

51. Case Knife.

Syn. Dutch Case Knife, the German Sword bean (Martens). According to the same authority it is known by the following names in various places: In Zurich, White-Seeded Sword-Grease-Pole bean; in Ulm and Stuttgart, High Sword bean; in Hohenheim, Large White Sword bean, Broadsword Pole bean; in Bopfingen, White Sword bean; in Munich, Largest Broadsword Pole bean; in England, Large Dutch Kidney bean; in Canada, Case Knife Runner bean, etc., etc.

A pole bean, growing six feet or over in height. It is said by Martens to grow as high as fifteen feet in Germany, rather slender. Foliage scanty. Leaflets broadly oval, slightly heart-shaped, almost as broad as long, short pointed. Flowers white. Pods, when fully developed, pale greenish yellow, straight or slightly sabre-form, very broad and very flat, scarcely distended by the beans, tipped with a slender bent point; when ripe very papery, light dun yellow, 7 to 7 1-2 inches long, containing about five beans. Fully developed beans white with veiny markings. Ripe beans oblong, very broad, kidney-form, strongly

flattened sidewise, occasionally compressed on the ends, white with veiny markings. Average size of ten beans, 5-8 inch long, 3-8 inch broad, 7-32 inch thick. It was in cultivation in this country in 1828.

52. MARSHALL.

A pole bean growing form seven to ten feet high. Foliage abundant, rather dark green. Leaflets large, broadly obovate, inclining to triangular, taper-pointed. Ripe pods much swollen and wrinkled, sabre-form, somewhat flattened, parchment like, light dun yellow, 6 1-2 to 7 inches long, containing from four to five beans. Ripe beans, oblong, very broad, kidney-form, quite strongly flattened sidewise, rarely compressed at the ends, pale dun yellow, striped with brighter yellow in rings concentric with the eye, a dark reddish brown ring about the eye. Average size of ten beans, 9-16 inch long, 11-32 inch broad, 7-32 inch thick.

53. YELLOW PODDED WHITE WAX.

A pole bean that with us was scarcely climbing, and very unhealthy throughout its whole growth. Flowers white. Pods, when fully developed, yellow; when ripe, strongly bent and wrinkled, somewhat swollen by the beans, rather flat, pale dun yellow, 5 3-4 to 6 3-4 inches long, containing from six to seven beans. Ripe beans oblong, kidney-form, quite strongly flattened sidewise, rarely slightly compressed on the ends, white with veiny markings. Average size of ten beans 5 8 inch long, 5-16 inch broad, 3-16 inch thick.

54. GIANT RED WAX.

A pole bean, with us only slightly climbing, not over two feet high. Foliage quite abundant. Leaflets rather large, broadly oval, slightly heart-shaped, short pointed. Pods, when fully developed, straight or nearly so, much swollen by the beans, pale yellow; when ripe, much curved, swollen and wrinkled, pale dun yellow, 5 to 6 1-2 inches long, containing about four beans. Ripe beans, oblong, very broad, not kidney-form, quite strongly flattened sidewise, rarely compressed on the ends, dark reddish brown. Average size of ten beans, 9-16 inch long, 3-8 inch broad, 1-4 inch thick.

55. LIMA.

By authors the Lima is regarded as specifically distinct from the garden bean, and is classed under *Phaseolus lunatus*, L.

The Lima is a pole bean reaching, under favorable circumstances, a height of ten feet, but requiring a somewhat warmer temperature than the Northern United States for perfect development. With us during the present season (1882) it made little or no attempt to climb the poles furnished it, but straggled along on the ground in a feeble way, showing plainly that the soil and season were unfavorable to its development. Foliage abundant, dark green, in many cases mottled with light green. Leaflets halberd shaped inclining to triangular, long, narrow taper pointed, on rather long petioles. Flowers small, white. Pods

leathery, short, very broad, flat, not much distended by the beans. Beans large, broad flat, more or less kidney-form, white or greenish white with veins radiating from the eye.

Several varieties are in cultivation, but owing to the cold and wet in the early part of the season those grown by us did not develop in sufficient perfection to bring out their distinctive characteristics. Among those attempted may be mentioned:

Bliss' Early, Dreer's Improved and New Challenger, all varieties more or less distinct of the White Lima.

Small White Lima, Syn. Frost, West Indian, Carolina, Carolina Sewee, Sieva, Saba. A smaller, earlier and more prolific variety than the common Lima.

Red Lima, a red variety, in all other respects resembling the White Lima, and Speckled Lima a variety mottled with red.

The Large White Lima and the Sieva were in cultivation in this country in 1828.

56. Scarlet Runner.

The Scarlet Runner is considered a distinct species and classed under *Phaseolus multiflorus*, Lam.

A tall growing pole bean with luxuriant foliage, rather dark green. Leaflets of medium size, broadly obovate, inclining to triangular, the lateral often unequally developed, rather short pointed. Flowers large, scarlet, borne in well-developed racemes. Pods, when fully developed, dark green, rough, sabre form ; when ripe, dark brown, almost cylindrical, parchment like, not greatly swollen by the beans, 5 1-2 to 6 1-2 inches long, containing about three beans. Ripe beans large, oblong, very slightly kidney-form, flattened sidewise, occasionally compressed on the ends, black mottled with dull lilac. Average size of ten beans 13 to 16 inches long, 1-2 inch broad, 5-16 inch thick.

57. White or Dutch Runner.

A variety of Scarlet Runner with white flowers and white beans, in all other respects scarcely to be distinguished from the Scarlet Runner. Both were in cultivation in this country in 1828.

58. French Yard Long.

Apparently identical with the Asparagus Bean of Burr, classed under *Dolichos sesquipedalis*.

A pole bean that apparently needs a warmer climate than ours for its perfect development. Stems very long but not tending to climb upwards, moderately leafy. Leaflets halberd shaped, long and narrow, taper pointed, very slightly pubescent. Flowers very large, purplish yellow. Pods very long, 18 to 24 inches, borne in pairs, almost cylindrical, not swollen by the beans, light green when approaching ripeness, very leathery, tipped with a very short blunt point, containing from ten to eleven beans. Fully developed beans very distant in the pods, light greenish tinged with red. Ripe beans small, oblong, kidney form, flattened sidewise, not compressed on the ends, dark brown with a black ring about the eye. Average size of ten beans 7-16 inch long, 7-32 inch broad, 5-32 inch thick. It was in cultivation in this country in 1828.

INDEX TO NAMES.

(The numbers refer to the number under which the variety is described.)

REPORT OF THE HORTICULTURIST.

INTRODUCTORY.

Our first year's work in the garden has had its embarrassments. To the cold backward spring was added the difficulties incident to a hurried beginning, the large amount of labor required in establishing the garden on a permanent basis, and the diversions from the garden demanded by other departments in fitting the Station for work.

Of necessity the greater part of the seed used was purchased. Some of the varieties proved to be mixed, others were not true to name, and a few failed entirely, owing doubtless in part to the heavy character of the soil and the cold wet weather of spring. The reputation of the seedsman did not prove a safe guide, for in some cases seeds from which most was expected turned out least reliable.

Much care and labor have been necessary to keep weeds under subjection. The soil of the garden which had evidently been well fertilized in former years was so thoroughly impregnated with weed seeds that rigid and frequent cultivation has been a positive necessity.

The extensive orchard of the Station, numbering more than eight hundred trees, was in sad need of pruning. This work was commenced March 20th and was prosecuted as rapidly as the weather and the pressure of other work would allow, one man being employed until April 20th, when it was completed.

The ground adjoining the lysimeter on the south and east was laid out and graded for a flower garden. The soil was trenched to the depth of eighteen inches and mixed with barn-yard manure. The outside walks, four feet in width, were excavated to the same depth and filled in with stones gathered from the garden and adjacent fields, and leveled on the surface with sifted gravel. The area was then laid out into thirty-six rectangular beds, twenty-two feet long by five feet wide, separated by narrow walks, and a border on the south and east sides four feet wide. These beds were planted with a variety of flowering plants, mostly annuals, and the greater part of them grew and blossomed beyond our expectations, forming a floral display that increased in brilliancy throughout the season.

A wild garden has been started on the ground bordering the brook that passes through the farm. It is designed to secure here specimens of all the more attractive hardy wild plants that can be obtained. More than a hundred species have already been planted out, some of which are very interesting and beautiful.

An assortment of small fruits has been put out, comprising two plants each of thirteen varieties of currants, five varieties of gooseberry, thirty-three of raspberry and six of blackberry, with fifty plants

each of three varieties of strawberry and a few plants of two species of the huckleberry (*Vaccinium*). Eleven varieties of grape, chiefly of the newer and comparatively untested varieties, have also been set out, together with a few plants of each of the four species of native grape, viz.: Vitis labrusca, V. aestivalis, V. cordifolia and V. riparia. The latter are intended to provide pollen for future hybridization for the purpose of securing improved varieties.

A water tank has been constructed in the garden, of brick, eight feet in diameter by three in depth, for convenience in watering plants and for making experiments with irrigation. It is connected with the main supply-pipe which has head sufficient to carry water to any part of the garden.

The lawn was in bad condition and contained a superfluous number of trees. The greater part of these have been removed, and a variety of the finer evergreens and flowering shrubs put out.

A small green-house with an office and work-room attached has been constructed to aid in performing those experiments in grafting, germination, etc., which require the conditions to be under constant control. This will allow important work to be carried on during the winter months.

Owing to cold weather in the latter days of March the hot-bed was not at the proper temperature for planting until April 6. The plow was started in the garden April 3 — doubtless a little premature for the best condition of the soil. The first planting (pease) was done April 4.

The work of the fruit-grower and gardener is becoming more and more a warfare with insects and diseases. Scarcely a fruit or a vegetable is without its blight, its bug, its borer or its decay. To discover the cause of these evils and to devise practicable remedies for them is a broad field for the experimental horticulturist. The following record of the success and failures in our first year's work is not offered as being in any sense the conclusive testimony. It is only the outline of the methods that have been pursued in feeling after knowledge.

BEET.

Seeds of nine varieties of beet were planted in the garden April 19, the temperature of the soil, prepared as for onions, being at 48 degrees. The dates of vegetation and yields of the varieties were as follows:

VARIETY.	Vegetated.	Days.	Yield, one row, 60 feet long.	Average weight of roots.	
			Lbs.	Lbs.	Oz.
Early Blood Turnip	May 7.	18	127¾	2	8
Early Yellow Turnip	May 7.	18	154¼	1	12
Dark Red Egyptian.............	May 8.	19	159¼	1	13
Long Smooth Blood	May 9.	20	111¼	3	10
Dewing's Imp. Blood Turnip ...	May 8.	19	119	1	14
Half Long Blood	May 7.	18	108¾	1	15
Early Flat Bassano	May 7.	18	180½	2	10
Pine Apple....................	May 7.	18	110½	1	3
Swiss Chard or Silver..........	May 7.	18	....	....	...

The Dark Red Egyptian beet deserves more than a passing notice. It was the earliest variety, being fit for use June 20, and is not surpassed in quality. With the exception of the tap root, which is very slender and clearly defined, it grows above ground, and where the plants were not thinned, the bulb-shaped portion of the root was frequently crowded upward to the height of two inches, being connected with the soil only by the elongated tap root. It has been pronounced "not very productive," but our experience would indicate that on fertile soil with the plants allowed to grow thickly in the row, it would hardly be surpassed in productiveness by any of the garden beets. The root cooks very sweet and tender, is finely colored and continues edible until autumn. The beet seed was planted in rows two feet apart and sixty feet long; one row of each variety. Weeds were kept down with the wheel hoe, those in the row being pulled by hand and the plants thinned when sufficiently large for table use to three inches apart in the row.

The Swiss Chard or Silver Beet belongs to Beta Cicla, a different botanical species from the other varieties, and is grown for the leaves, which are used as greens, or the stems and midribs are cooked and served like asparagus. These were fit for use after June 20 throughout the summer, and were pronounced quite superior as greens.

Samples of several varieties of so-called ornamental beets were also grown. Their broad showy petioles and midribs, variously and often brilliantly colored, with beautifully crimpled green or purple leaves, gave them a unique appearance and attracted much attention from visitors. The more showy varieties might be grown with fine effect as a remote border in the flower garden, but the foliage is rather coarse for use in the foreground.

CARROTS.

Eight varieties of carrot were planted April 19 in soil prepared as for onions. The cultivation was the same as given to the beet, the plants being thinned in the row June 20 to three inches apart. The varieties with the statistics noted were as follows:

VARIETY.	Vegetated.	Days.	Yield, one row sixty feet long.	Average weight of root
			Lbs.	Oz.
Early Horn	May 8	19	85¾	7
Extra Early Forcing	May 8	19	76¾	8
Half Long Luc	May 9	20	96	17½
Half Long Red Pointed	May 9	20	104¾	16
Half Long Carenton	May 8	19	74½	10
Half Long Stump-rooted	May 8	19	114¼	13¾
Long Orange	May 9	20	124¼	14
Long White	May 8	19	153¼	17

The Extra Early Forcing and the Early Horn, which have a striking resemblance to each other, were the earliest two sorts. Much difference was noted in amount of foliage of the different varieties, it being very luxuriant in the Half Long Red Pointed and Long White, and very scanty in the Half Long Carenton and Extra Early Forcing.

WINTER RADISH.

Seeds of the California Mammoth, Chinese White and Black Spanish Winter Radish were planted in the garden May 30, the temperature of the soil being 48°.

These vegetated June 8. In the latter part of July the first two varieties bloomed, ripening their seed late in the autumn. The Black Spanish variety did not bloom. Harvested October 30, the varieties yielded as follows, one row of each, forty feet long:

	Pounds.
California Mammoth	37 3-4
Chinese White	79 1-2
Black Spanish	77 1-4

The first two varieties were obviously planted too early, as was shown by the prompt appearance of bloom. All of the varieties were for eating, less tender and more acrid than the common radish, and we think possess few qualities that would entitle them to a place in American gardens.

TURNIP.

The season was very unfavorable for turnips, very little rain having fallen during their season of growth. Our comparative test of twenty-nine varieties may not, however, have less value, as it indicates which sorts are best able to endure adverse conditions. The seed was sown July 8, in drills two feet apart and sixteen feet long, four rows of each variety, on well prepared but unmanured soil. Weeds were kept down between the rows with the wheel hoe, and the plants thinned when of proper size.

The varieties, dates of vegetation, etc., and yields, were as follows:

	Vegetated.	Days.	Of edible size.	Days.	Yield 4 rows, lbs.	Weight of average specimens, oz.
White Egg,	July 18.	5	Oct. 12.	96	14 1-4	5 3-8
Black Stone,	July 18.	5	Sept. 22.	76	25 3-4	6 1-2
Gray Stone,	July 18.	5	Oct. 12.	96	3 1-4	9 7-8
White Dutch,	July 18.	5	Sept. 22.	76	32 1-4	7 1-8
Cow Horn,	July 18.	5	Oct. 27.	111	18	6 1-9
Cow Horn Strap-Leaf,	July 18.	5	Oct. 12.	96	12	7 1-3
Red Top,	July 18.	5	Oct. 5.	89	35	9 1-6
Red Top Strap-Leaf,	July 18.	5	Sept. 22.	76	27 3-8	9 5-6
White Strap-Leaf,	July 18.	5	Oct. 12.	96	11 1-8	4
Long Strap-Leaf,	July 18.	5	Oct. 17.	101	9 1-4	5 1-3
White Flat or Globe,	July 18.	5	....	...	21 3-8	9 1-2
Pomeranian White Globe,	July 18.	5	Sept. 30.	84	22	11 2-3
Green Globe,	July 18.	5	Oct. 12.	96	14 3-4	8 1-6
Green Barrel,	July 18.	5	Sept. 22.	76	24	13 2-3
Jersey Navet,	July 18.	5	Sept. 30.	84	35 3-4	9 1-6
Long White Tankard,	July 18.	5	Oct. 5.	89	22 3-4	5
Yellow Malta,	July 18.	5	Sept. 30.	84	5 1-2	7 1-6
Yellow Stone,	July 18.	5	Oct. 27.	111	7 7-8	5
Robson's Golden Ball,	July 18.	5	Oct. 12.	96	5 5-8	4
Orange Jelly,	July 18.	5	Oct. 12.	96	3 1-2	5 1-3
New Yellow Finland,	July 14.	6	Oct. 12.	96	5	6 3-4
Montmagney,	July 18.	5	Sept. 30.	84	23 3-4	6 1-6
White Ruta Baga,	July 18.	5	Oct. 12.	96	23 3-4	11
Improved Ruta Baga,	July 18.	5	Sept. 22.	76	49	9
Skirving's Ruta Baga,	July 18.	5	Sept. 22.	76	50 1-4	15 2-3
Laing's Ruta Baga,	July 14.	6	Sept. 30.	84	43 3-4	13 1-2
Curley-Top Ruta Baga,	July 18.	5	Sept. 30.	84	47 1-4	15 1-6
Bloomsdale Ruta Baga,	July 18.	5	Sept. 22.	76	51 1-4	18
German Teltow,	July 18.	5	....	..	... ..	......

The German Teltow is a very small variety, the roots growing scarcely larger than the finger, and the leaves little larger than those of a radish. In foreign catalogues recommended for pickling.

As will appear from the table, the most productive varieties of the common turnip were Jersey Navet, Red Top, Red Top Strap-Leaf and White Dutch; of ruta bagas, or Swede turnips, Bloomsdale and Skirving's. We append descriptions of these varieties as grown in the Station garden.

Jersey Navet. Foliage rather abundant, neck small, root obovate, growing about half above ground, skin white below the soil, cream-colored above. Fine specimens measure three inches in diameter and four and a half inches long. The flesh cooked is white, without fiber, sweet and entirely free from the strong flavor possessed by many varieties.

Red Top, syn. "Red Top Flat," "Purple Top Flat" (Burr).

Root roundish, flattened, growing nearly half above ground, neck and tap-root small, skin reddish-purple above, white below, flesh white and close-grained while young, becoming dry and spongy, flavor somewhat bitter. Average specimens measure three and a half inches in diameter and three inches in depth.

White Dutch, syn. "Early Flat Dutch," "Early White Dutch," "White Dutch" (Burr). "Spring Turnip" (D. J. B.)

Root much flattened, produced mostly within the earth; skin white, somewhat washed with green at the insertion of the leaves; flesh fine grained, tender and sweet while young, becoming spongy and juiceless

when the root is full grown. Average specimens measure four inches in diameter, and two and a half in depth.

Red Top Strap Leaf, syn. "Purple Top Strap-Leaved."

Leaves few, upright, broad, rounded at the ends, and tapering to the very small neck; root flat, smooth and regular, often concave below, growing mostly above ground; skin bright purple above, white below, often finely clouded or shaded at the union of the colors; flesh white, solid, mild and well flavored. Size medium, average specimens measuring four inches in diameter, and two and a half in depth. "It is early, hardy, thrives in almost any description of soil, and rarely fails to produce a good crop.

Bloomsdale Ruta baga. Shape nearly globular, neck short, grows mostly above ground; deep purple about the crown, often rough and netted; flesh yellow, very sweet and excellent. Average specimens measured four inches in diameter, and three and a half in depth.

Skirving's Ruta baga. Originated with William Skirving, of Liverpool, and introduced by him in 1837. Roots oblong, sometimes conical, growing much above ground; smooth, with few fibrous roots; skin deep purple above, sometimes beautifully marked with green; yellow below; neck long; flesh yellow, solid, sweet and well-flavored. Average specimens measure four inches in diameter and six inches long.

Onion.

Our experiments with the onion consisted of a comparative test of four varieties, and in planting in rows at different distances apart. Seeds of the same variety obtained from different sources were treated as distinct varieties.

The soil received a moderate dressing of stable manure, and after plowing was top-dressed with hen manure. The surface was then thoroughly pulverized with the smoothing harrow and "board drag."

The seed was planted April 15th, the temperature of the soil one inch deep at 7 A. M., being 32°, in rows sixty feet long, and two feet apart. It was sown by hand in moderate and uniform thickness, and covered half an inch deep.

To find the percentage of germination of the seed in the various packages received, one hundred seeds were taken from each package April 8th, and placed in the hot-bed between sheets of moist blotting paper. The result, with the varieties, time of vegetation and maturity, yield, etc., will appear in the following table:

	Vegetation.	Days.	Ripe.	Days.	Yield, row, lbs.	Yield per acre, bush.	Per cent of veg.
Yellow Danvers, Henderson	May 7	22	Aug. 31	138	56	391	...
Yellow Danvers, Bliss	May 8	23	Aug. 31	138	55	384	62
Yellow Danvers, Gregory	May 7	22	Aug. 31	138	55	384	67
Yellow Danvers, Wells	May 7	22	Aug. 31	138	61½	429	89
Red Wethersfield, Bliss	May 7	22	Aug. 31	138	57¾	403	85
Red Wethersfield, Wells	May 7	22	Aug. 31	138	73	510	87
Red Wethersfield, Henderson	May 7	22	Aug. 31	138	50	349	61
Extra Early Red, Wells	May 7	22	Aug. 31	138	61½	429	68
White Portugal, Bliss	May 7	22	Sept. 17	155	52¾	368	66

The weeds were kept down with the wheel-hoe, those in the row being pulled by hand. The bulbs were not thinned. No difference appeared in the foliage of the several varieties.

The bulbs were pulled on the days noted in the table as "ripe," left on the ground a few days to dry, topped, and the product of each row weighed.

Superiority was claimed for the samples of seed from the Messrs. Wells, and the results seem to justify the claims; indicating in the case of the Yellow Danvers, a larger yield by forty-three bushels per acre than the average product of the seeds from other sources, and in the Red Wethersfield an increase of 131 bushels per acre over the average yield of the other samples.

It was noted that where the bulbs grew thickest in the row there were fewer thick-necked specimens, or "scallions," than where they were more remote from each other.

The appearances indicated that it is policy for the onion grower to fertilize his ground abundantly, allowing the bulbs to grow thickly, rather than to plant on soil of moderate fertility, and depend on thinning to secure bulbs of merchantable size. The bulbs will find room to develop, if the soil contains sufficient nourishment, even if very much crowded.

It appears from the table that the lowest rate of germination is accompanied by the smallest yield, and that the highest three rates of germination are accompanied by large yields. This suggests the importance of testing different samples of seed before planting.

The second experiment with onions consisted in planting the Yellow Danvers variety in rows one foot and two feet apart, respectively, for the purpose of comparing the yields per equal areas, the same sample of seed being used in both cases. Rows planted one foot apart yielded at the rate of 480 bushels per acre, while those planted two feet apart yielded at the rate of 384 bushels per acre.

For table use we found the White Portugal variety, synonym "Silver-skin," superior to the others. The bulb grows to medium size, is flattened, with a small neck, and a silvery white skin. The flesh is white, fine grained, sweet and remarkably mild.

THE ENGLISH FRAME CUCUMBER.

A few seeds of a single variety of English Frame Cucumber—Giant of Armstadt—planted in the garden May 30, vegetated June 14, flowered July 23, was at edible maturity during August, and October 4. The fruit grew somewhat larger than that of the well-known Long Green variety, and was very tender, exceedingly crisp, and of finer flavor than any garden varieties tested. Although the fruit assumed all the appearance of ripeness the seeds proved to be but empty seed-cases.

MELON.

Eight varieties of musk melon and twelve of watermelon were planted in hills prepared as described for squashes. Owing to dry weather and heavy soil, a large proportion of the seeds failed to vegetate, though none of the varieties failed entirely. The growth of the

vines was so much retarded by the coolness of June and the drouth of July, that at one time we almost despaired of our melon vines ripening any fruit. Several varieties of musk melon, however, matured a fair crop. Of these, the Christiana, Sill's Hybrid, Shaw's Golden Superb, and Green Persian were most productive; the other sorts noted as having matured, producing but a few samples each.

The watermelons must be rated as a failure, only one variety, the Strawberry, having ripened more than a single fruit. This statement, however, does slight injustice to a few sorts, the fruit of which was pilfered before coming to maturity.

The varieties, dates of planting, vegetation, etc., were as follows:

MUSK MELON.	Planted.	Vegetat'd.	Days.	Bloss'm'd.	Days.	Ripe.	Days
Green Persian	May 22	June 14	23	July 20	59	Sept. 9	110
Early Nutmeg............	May 22	June 13	22	July 20	59	Sept. 9	110
Sill's Hybrid	May 22	June 13	22	July 24	63	Sept. 20	121
Shaw's Golden Superb...	May 22	June 15	24	July 29	68	Sept. 22	123
Hackensack...............	May 22	June 14	23	July 28	67	Sept. 11	112
New Surprise............	May 22	June 14	23	July 24	63	Sept. 9	110
Black Portugal...........	May 22	June 12	21	July 24	63		
Christiana...............	May 26					Sept. 9	106
WATERMELON.							
Phinney's New	May 22	June 14	23	July 28	67		
Strawberry	May 22	June 14	23	July 28	67	Sept. 16	117
Odella.....................	May 22	June 14	23	July 29	68		
Long Hill.................	May 22	June 14	23	July 29	68		
Cream Fleshed...........	May 22	June 15	24	July 31	70		
Orange....................	May 22	June 17	26	July 31	70	Oct. 7	138
Vick's Early.....	May 22	June 15	24	Aug. 3	73	Oct. 12	143
Gipsy	May 22	June 14	23	Aug. 1	71		
Rattlesnake	May 22	June 14	23	Aug. 3	73		
Ferry's Peerless	June 3	June 16	13	Aug. 1	58		
Mountain Sweet..........	June 3	June 16	13	Aug. 1	58		
Excelsior................	May 22	June 15	24			Oct. 7	138

The hills were prepared by spading in a liberal quantity of barnyard manure, and a portion of them were covered, after planting, with plant protectors, made by tacking a bit of mosquito netting, over a frame-work of light wooden hoops. The vines not thus protected were saved from the ravages of the striped bug *Diabrotica vittata*, Fabr. by an occasional application of water-slacked lime.

Several plantings of the Christiana melon were made at different times to discover the effect of early planting on the time of maturity. A few seeds planted on inverted sods in the hot-bed, April 15th, vegetated April 20th, and were transplanted to the open ground May 1st. Severe weather followed, during which the soil froze to the depth of an inch, and the plants, though well protected, were destroyed.

Seeds were also planted in the open ground April 15th; a few of which vegetated May 26th, but these plants did not mature fruit earlier than others planted a month later.

We made the experiment of planting the Christiana melon in drills ten feet apart. The result was satisfactory, giving a much larger crop of fruit than an equal area planted in hills. The vines did not crowd

each other, and were neither less prolific nor less productive than others planted in hills, and were more easily cared for.

Two of these drills were fertilized with sulphate of potash (potash salts); one at the rate of 12 pounds to 100 feet, and the other at the rate of 40 pounds for the same length. The fertilizer seemed to retard somewhat the growth of the vines and the maturity of the fruit, but the melons produced were of very superior flavor. The larger quantity of potash showed no more effects than the smaller.

The Christiana melon, as grown the past season in the Station garden, possessed qualities that would lead us to recommend it highly as a garden variety. It is medium in size, roundish, with prominent ribs, the color deep green, thickly mottled with grayish white, the green ground becoming a shade lighter as the fruit ripens. The flesh is from an inch to an inch and a half thick, of a rich orange color, tender and melting quite to the rind, which is thin. The fruit invariably separates from the stem as soon as ripe. In earliness, hardiness and prolificacy it was not surpassed by any variety tested.

The original Christiana originated with Capt. Josiah Lovett of Beverly, Mass., but the superiority of the fruit as grown at the Station is perhaps largely due to the quality of the seed, which was from a stock known to have been carefully selected for many years.

SQUASH.

Two plantings of squash were made. In one, May 24th, the varieties were isolated to prevent hybridization, and in the other, June 3d, intermingled for the purpose of noting the effect of hybridization. The hills, which received fifteen seeds each, were prepared by spading in a liberal quantity of well-rotted manure.

The varieties, dates of planting, vegetation and blooming, yields, and number of hills planted were as follows;

VARIETY.	Planted.	Soil temp. 7 A. M. 1 inch deep.	Vegetated.	Days	Bloomed.	Days	No. hills pl't'd	No. of fruits of edible size.
Early White Scallop Bush,	May 24	48°	June 9	16	July 20	57	2	8
Early Yellow Scallop Bush.	May 24	48°	" 13	20	" 24	61	2	2
Summer Crookneck, .	May 24	48°	" 10	17	" 20	57	2	8
	May 24	48°	" 7	14	" 21	58		
Low's Premium Hybrid,	June 8	56°	" 16	18	" 27	54	4	9
	May 24	48°	" 10	17	" 21	58		
Little Cocoanut, .	June 8	56°	" 16	18	" 28	55	4	70
	May 24	48°	" 10	17	" 21	58		
Ohio, ...	June 8	56°	" 14	11	" 27	54	4	8
	May 24	48°	" 9	16	" 22	59		
Turban, . . .	June 8	56°	" 14	11	" 28	55	4	7
	May 24	48°	" 7	14	" 27	59		
Boston Marrow, . .	June 8	56°	" 15	12	" 26	53	4	2
	May 24	48°	" 12	19	" 24	61		
Green Striped Bergen,	June 8	56°	" 17	14	" 26	58	4	16
	May 24	48°	" 7	14	" 24	61		
New Marblehead, . .	June 8	56°	" 17	14	" 26	58	4	00
	May 24	48°	" 7	14	" 25	62		
Butmen, ...	June 8	56°	" 16	13	" 27	54	4	12
	May 24	48°	" 9	16	" 28	65		
Mammoth Chile, . .	June 8	56°	" 16	18	" 29	56	4	00
	May 24	48°	" 10	17	" 31	68		
Yokohama, . .	June 8	56°	" 14	11	" 28	55	4	[illegible]
	May 24	48°	" 14	21	Aug. 6	72		
Canada Crookneck, .	June 8	56°	" 14	11	July 31	58	4	42
	May 24	48°	" 15	22	Aug. 1	68		
Winter Crookneck, .	June 8	56°	" 14	11	" 8	61	4	18
	May 24	48°	" 12	19	" 9	77		
Perfect Gem, . .	June 8	56°	" 17	14	" 14	72	4	18
	May 24	48°	" 7	14	" 24	61		
Hubbard, . . .	June 8	56°	" 14	11	" 26	58	8	47

In fourteen varieties, ten days' earliness in the two plantings was followed by an average earliness of three days in the time of vegetation, and six days in the time of blooming.

Owing to the difficulty of noting corresponding stages of maturity, the date of ripeness of the several varieties is omitted. The first squash (Early White Scallop Bush) was picked for the table August 11.

Damage from the "striped bug," *Diabrotica Vittata* (Fabr.), was prevented by dusting the vines, as often as attacked with fresh-slacked lime.

A more formable enemy appeared in the "squash borer," *Ægeria Cucurbitæ* (Harris). July 31 vines of certain varieties were noted as turning yellow, and August 3 the work of this insect was distinctly visible.

We quote from Harris' "Insects Injurious to Vegetation:" "During the month of August the squash and other cucurbitaceous vines are frequently found to die suddenly down to the root. The cause of this premature death is a little borer which begins its operations near the ground, perforates the stem, and devours the interior. It afterward enters the soil, forms a cocoon of a gummy substance, covered with particles of earth, changes to a chrysalis, and comes forth the next summer a winged insect. This is conspicuous for its orange-

colored body, spotted with black, and its hind legs fringed with long orange colored and black hairs. The hind wings only are transparent, the fore wings expand from one inch to one inch and a half. It deposits its egg on the vines close to the roots, and may be seen flying about the plants from the tenth of July to the middle of August."

The ravages of this insect were confined chiefly to certain varieties, proving fatal in the case of the New Marblehead and Mammoth Chile, while in Yokohama, Winter Crookneck, Canada Crookneck, Little Cocoanut, Green Striped Bergen and Perfect Gem, the damage was scarcely perceptible. The vines of the latter varieties were conspicuous throughout the season by the deep green color of their foliage. We have never seen the ravages of this insect so severe as on the Station farm. In a section six inches long of the stem of the Low's Premium Hybrid squash, six grubs were found, each an inch long. The injuries were not confined to the squash, but included the destruction in many instances of cucumber and pumpkin vines.

It seemed difficult to devise means for attacking an enemy that commits its depredations concealed in the heart of the plant. At the suggestion of Prof. W. R. Lazenby of the Ohio State University, we tried injecting bisulphide of carbon about the roots of a few plants in the latter part of August. The results were such as to encourage hope of success if the application were made at the first indications of the insect, and continued at frequent intervals throughout the season. Our plants, however, were so infected with worms when operated upon that our success was but partial. We hope in the future to make more extended experiments in this line.

The experience of the past season would lead us to recommend the Canada Crookneck for garden culture. This variety yielded more in weight than any other, and its table qualities, though surpassed by other sorts, are very good. The plant is very hardy and suffers little from the attacks of insects, the deep green of the foliage making it conspicuous when planted with less hardy varieties. The fruit is of medium size unusually "crooknecked," often slightly ribbed, cream-yellow when ripe. Flesh salmon-red, close grained, sweet and well flavored. Its keeping qualities are said to be very good.

A few seeds of the Vegetable Marrow squash were planted in the garden May 26. The plants made a luxuriant growth, often ten or twelve feet in length, yielding fruit from eight to ten inches long, of an oblong oval form, distinctly ribbed, of a straw color when ripe, with a very hard shell. The flesh is white and watery when cooked before the fruit is ripe.

As will appear from the yields of the different varieties as noted in the table, the squashes must be rated as little less than a failure. This result is doubtless largely due to the extremely heavy character of the soil in which they were planted.

CABBAGE.

Twenty-eight varieties of cabbage were tested in garden culture. The seeds, thirty of each sort, were planted in the cold-frame April 7th and 8th, with the soil temperature of 52°, and the plants transplanted to the garden May 27th, in rows three feet apart, and two feet apart in the rows.

The soil received a moderate dressing of barn-yard manure, and after being plowed and harrowed, was "spatted" by hand. The plants were cultivated throughout the season with the hoe.

In order to secure a fair comparative test the so-called late varieties were treated as "early" cabbages. It is possible, however, that the late sorts would have made a better showing, had their planting been delayed a month.

The statistics noted are as follows.

VARIETY.	Planted.	Vegetated.	Days.	Edible maturity.	Days.	Number seeds vegetated.	Number genuine plants.	Number heads.	Average weight of heads.
Early Oxheart	April 8	April 18	10	July 26	109	...	27	23	2 lbs. 3 ozs.
Nonpareil	April 8	April 18	10	July 26	109	...	...	...	1 lb. 9 3-4 ozs.
Vilmorin's Early Flat Dutch	April 8	April 18	10	July 28	111	19	19	17	4 lbs.
Newark Early Flat Dutch	April 7	April 17	10	July 28	112	22	22	19	5 lbs. 6 ozs.
Early Ulm Savoy	April 8	April 17	9	Aug. 1	114	29	15	7	....
Early Jersey Wakefield	April 7	April 17	10	Aug. 1	115	28	24	17	3 lbs. 6 3-4 ozs.
Early Winnigstadt	April 7	....	..	Aug. 1	115	23	23	23	3 lbs. 8 3-4 ozs.
Cannon Ball	April 8	April 18	10	Aug. 4	117	15	15	12	2 lbs. 9 1-4 ozs.
Little Pixie	April 7	April 17	10	Aug. 4	118	25	25	21	1 lb. 13 ozs.
Henderson's Early Summer	April 8	April 17	9	Aug. 11	125	28	13	10	3 lbs. 5 1-2 ozs.
Crane's Early	April 8	April 21	13	Aug. 11	125	19	16	16	3 lbs.
Schweinfurt Quintal	April 8	April 18	10	Aug. 11	125	29	25	24	7 lbs.
Early Blood Red Erfurt	April 7	April 17	10	Aug. 11	126	25	24	22	1 lb. 15 3-4 ozs.
Sugar Loaf	April 8	April 18	10	Aug. 15	129	23	15	9	2 lbs. 3 1-4 ozs.
Fottler's Impr'v'd E'rly Brunswick,	April 7	April 17	10	Aug. 15	130	28	24	12	7 lbs. 6 3-4 ozs.
Large York	April 7	April 17	10	Aug. 15	130	16	19	10	14 3-4 ozs.
Premium Flat Dutch	April 8	April 18	10	Aug. 22	136	19	17	14	4 lbs. 1 oz.
Improved American Savoy	April 8	April 17	9	Aug. 22	136	27	13	8	1 lb. 6 1-2 ozs.
Early Bleichfeld	April 8	April 18	10	Aug. 22	136	22	21	10	2 lbs. 6 1-4 ozs.
Early York	April 8	....	...	Aug. 22	136	22	19	5	1 lb. 3 ozs.
Stone Mason	April 7	April 17	10	Aug. 22	137	22	22	14	5 lbs. 1-2 oz.
Red Drumhead	April 7	April 17	10	Aug. 22	137	22	22	14	2 lbs. 7 1-2 ozs.
Drumhead Savoy	April 7	April 18	11	Aug. 22	137	19	15	7	2 lbs. 6 ozs.
Red Dutch	April 7	April 17	10	Aug. 22	137	24	24	20	2 lbs. 5 3-4 ozs.
Danish Drumhead	April 7	April 17	10	Aug. 15	130	28	22	18	3 lbs. 10 1-2 ozs.
Green Glazed	April 7	....	..	....	...	27	20	4	....
Bergen Drumhead	April 7	April 27	20	Oct. 17	193	12	9	5	2 lbs. 8 1-2 ozs.
St. Dennis Drumhead	April 7	....	...	Sept. 1	145	23	18	6	3 lbs. 4 1-2 ozs.

The seed in several of the packages used was mixed, some not producing more than half of the plants true to name. So far as discovered, spurious plants were rejected in noting the yield.

The Green Glazed variety made a luxuriant growth of leaves, but formed no heads until very late; the first being noted November 9th. The Early York was quite late, having formed but one head by August 22d. The heads of the red cabbages were extremely solid.

Early in summer the cabbage butterfly *Pieris rapae*, L., was seen flying about the plants, and in the latter part of June, the first brood of caterpillars appeared. These did less destruction, however, than the second, which came about the middle of August. This pest is supposed to have been introduced into this country from Europe, probably in the egg state from cabbage leaves, thrown off from some vessel. It appeared in the vicinity of Quebec about the year 1856, whence it has gradually spread throughout Canada and the Eastern and Middle States. The eggs, which are deposited on the under sides of the leaves in May or June, hatch in about ten days; the caterpillar attains its growth in about three weeks; passes its chrysalis in eight days and comes forth a perfect insect in time for the second brood, which passes

the winter in the chrysalis state. The gardener is indebted for help in suppressing this enemy to a species of chalcis fly, which destroys vast numbers of the chrysalids.

In order to test the efficiency of a few of the so-called remedies for the cabbage worm, we confined some of the caterpillars in a bottle and noted their behavior under various applications. One specimen confined for three hours in a bottle partly filled with black pepper, crawled away, discolored by the powder, but apparently unharmed; a second repeatedly immersed in a solution of saltpeter, and a third in one of boracic acid, exhibited little inconvenience. Bisulphide of carbon, however, produced instant death when applied to the worm, though the fumes were not fatal. The fumes of benzine as well as the liquid caused almost instant death, but when applied to the cabbages small whitish excrescences appeared on the leaves. Hot water applied to the cabbage destroyed a portion of the worms, causing also the leaves to turn yellow. One ounce of saltpeter and two pounds of common salt dissolved in three gallons of water applied, was partly efficient. The most satisfactory remedy tested, however, consisted of a mixture of one-half pound each of hard soap and kerosene oil in three gallons of water. This was applied August 26th, and examination the following day showed many, though not all of the worms destroyed.

The growing cabbage presents such a mass of leaves in which the caterpillars may be concealed, that it is hardly possible to reach all the worms at one application. It is important, therefore, to repeat the use of any remedy at frequent intervals.

July 24th the lower leaves on several plants of the Drumhead Savoy cabbage appeared to be turning yellow and shriveling. Examination revealed that the stems of these plants and the midribs of the leaves were suffering from the attack of an insect that burrowed in them, somewhat as the squash borer, *Ageria cucurbitæ*, burrows in the stem of the squash. For a time the insect which caused the damage could not be found. At length, however, several small brown maggots were found in the stem of one of the plants. A section of the stem containing one of these was placed under bell glass, and in a few days the maggot developed into a fly about the size of the common house fly. The insect deposited eggs in the section of the stem from which it hatched and then died. As we could find no description of the insect, we sent it with a section of the injured stem to J. Henry Comstock, Professor of Entomology in Cornell University, who pronounced it "an undescribed species of the *genus Mydæa*. This genus is one of the Anthomyidae, the family of flies to which the well-known cabbage maggot which infests the stem and root of the cabbage belongs."

The insect proved fatal to the plants which it infested, and it did not disappear until frost came in October. The area of its operations was, however, confined to a few square rods.

Seeds of eight of the above-named varieties were planted "in place" May 31 on soil which had received no manure. Several seeds were placed in each hill, and where too thick the plants were thinned out, the extras being used to fill out vacant spaces. No cultivation was given other than that usually given to corn. The number of hills of each variety was twenty-six, and the plants that survived with the number of heads formed were as follows:

VARIETY.	No. plants.	No. heads.
Schweinfurt Quintal	26	17
Early Winnigstadt	23	11
Premium Flat Dutch	26	2
Little Pixie	19	2
Cannon Ball	18	6
Nonpareil	13	6
Bergen Drumhead	10	......
Drumhead Savoy	6	......

The experience of the past season would lead us to recommend the Early Oxheart as a "first early" variety. The Early Flat Dutch, Winnigstadt and Schweinfurt Quintal as intermediates, and the Premium Flat Dutch as a late variety.

We append descriptions of these:

Early Oxheart, syn. "*Small Oxheart*," "*Oxheart*," "*Petit Cœur de Bœuf*," from France. Head rather small, roundish, oval, leaves light green; those outside of the head few in number, stem short. Owing to its small size it may be grown sixteen inches apart, in rows two feet apart.

Newark Early Flat Dutch. A cross between the Old Large Flat Dutch and Early Oxheart. A dwarf variety. Head large, roundish, nearly flat on the top. Largely grown by market gardeners about New York. The Vilmorin Early Flat Dutch is a French strain of this variety, differing slightly in the form of the head.

Winnigstadt, syn. "*Pointed Head*," "*Winnigstadt Pointed Head*," "*Pointu de Winnigstadt*." A German variety. Head of medium size. Conical extremely solid. Leaves of the head yellowish green with large veins and midribs; exterior leaves large, short and rounded, smooth; stem short; heads keep well during winter.

Schweinfurt Quintal, syn. "*Early Schweinfurt*," "*Large Early Schweinfurt*," "*Schweinfurt*," "*Chou d'Allemande*," "*Chou d'Alsace*," "*Chou Quintal*," from Germany. Heads large, flattish, round, very symmetrical, distinct from the exterior leaves, not very solid, but superior in tenderness and flavor. Stem short and thick. Leaves large, somewhat festooned, of a clear green color. Seeds of this variety were distributed from the patent office in 1854.

Premium Flat Dutch, syn. "*Large Flat Dutch*," "*Premium Large Late Flat Dutch*," "*Bloomsdale Late Flat Dutch*." Heads large, round, solid, broad and flat on the top, bluish green, often tinted with red or brown. Exterior leaves rather numerous, roundish, broad, somewhat ruffled at the edges, which often assume a purple cast late in the season. Stem short. In some strains the heads are round on the top.

Thirty seeds each of three varieties of Cauliflower, three of Kohl Rabi, one of Broccoli and one of Brussels Sprouts, planted in the cold frame April 7 and 8, vegetated as follows:

	Planted.	Vegetated.	Days.	Number vegetated
Ex. Early Dwarf Erfurt Cauliflower...	April 7	April 17	10	24
Early Dwarf Erfurt Cauliflower......	April 7	April 17	10	21
Large Early London Cauliflower.....	April 7	April 18	11	15
Large Early White Kohl Rabi.......	April 8	April 19	11	22
Large Early Purple Kohl Rabi.......	April 8	April 19	11	18
Large Late Green Kohl Rabi..........	April 8	April 19	11	21
Purple Broccoli..........................	April 8	April 20	12	..
Brussels Sprouts........................	April 7	April 18	11	26

The plants were transplanted to the garden May 29 in soil prepared as described for cabbage.

Of Cauliflower the Extra Early Dwarf Erfurt was slightly earlier than the Early Dwarf Erfurt and produced double the proportion of good heads, the latter variety forming heads on two-fifths of the plants. The third variety perfected no heads.

All of the varieties of Kohl Rabi made a rapid growth, and little difference was noticed in their earliness. The Large Late Green Variety was noted at edible maturity July 16, at which time the other sorts were slightly behind in size. The thick stems continued to enlarge slowly throughout the season, frequently bursting and developing into grotesque forms, attaining in a few instances a weight of eight pounds. The varieties differed little except in the color of the stems and foliage.

The Broccoli made a luxuriant growth of leaves, some of which grew to the height of two and a half feet, but showed no indications of forming heads.

The Brussels Sprouts also made a vigorous growth, and twenty out of twenty-five plants formed heads of edible size. Late in the season the stems were infested by myriads of aphides which rendered a large part of the heads unfit for use.

Four varieties of Borecoles or Kales were planted in the garden April 20th, the temperature of the soil being 47°. The seeds vegetated as follows:

Variety.	Vegetated.	Days.
Dwarf German Greens..........................	May 6	16
Green Curled....................................	May 8	18
Dwarf Purple Curled...........................	May 10	20
Cottagers' Kale.................................	May 9	19

Heavy reins about the time of vegetation destroyed the greater part of the plants. The surviving ones, however, made a fine growth. The Cottagers' Kale was evidently spurious, as the plants grew two and a half feet high, while the true variety grows but one foot high.

The close alliance of the various plants of the Brassica family was frequently observed. On August 22d a plant of Newark Early Flat Dutch Cabbage was noted as having formed several small heads about

the stem, after the manner of Brussels Sprouts. October 27 a plant of Cauliflower was observed as showing an inclination to form a head like cabbage. The Broccoli which failed to head resembled Borecole and the Borecoles showed axillary buds, reminding one of Brussels Sprouts. In the cold-frame the young plants of Brussels Sprouts, Kohl Rabi, and Cauliflower differed less from one another than some of the varieties of cabbage.

Sweet Corn.

Sixteen varieties of sweet corn tested in the garden gave the following results :

	Planted.	Vegetated.	Days.	Bloomed.	Days.	At edible maturity.	Days.	Ripe.	Days
Narraganset	May 26	June 10	15	July 29	64	Aug. 8	74	Sept. 11	108
Crosby's Early	May 22	June 9	18	July 29	68	Aug. 11	81	Sept. 11	112
Minnesota	May 26	June 10	15	July 29	64	Aug. 11	77	Sept. 11	108
Marblehead	May 26	June 10	15	July 29	64	Aun. 11	77	Sept. 11	108
Tom Thumb	May 26	June 12	17	July 29	64	....	....	Sept. 11	108
Triumph	May 23	June 9	17	July 31	69	Aug. 21	90	Sept. 17	117
Stowell's Evergreen	May 23	June 9	17	Aug. 3	72	Aug. 24	93	Sept. 17	117
Concord	May 24	June 9	16	Aug. 3	71	Aug. 24	92	Sept. 17	116
Early Eight-rowed	May 24	June 9	16	Aug. 3	71	Aug. 24	92	Sept. 17	116
Darling's Early	May 26	June 10	15	Ang. 3	69	Aug. 24	90	Sept. 17	114
Mammoth Sweet	May 22	June 9	18	Aug. 6	76	Aug. 31	101	Sept. 20	121
Black Sugar	May 24	June 10	17	Aug. 5	73	Aug. 31	99	Sept. 20	119
Black Mexican	May 26	June 12	17	....	...	Sept. 1	98	Sept. 27	124
Hopkins	May 26	June 12	17	Aug. 3	69	Sept. 5	102	....	...
Egyptian Sweet	May 24	June 10	17	Aug. 14	82	Sept. 11	110	Oct. 3	132
Ne Plus Ultra	May 26	June 12	17	....	...	Sept. 27	124	....	....

The yield of the different varieties was not noted, as the amounts used for the table were not known. The Mammoth, Stowell's Evergreen and Early Eight-rowed were perhaps the most productive three varieties. Little difference appeared in the earliness or the size or number of the ears of the first five of the list. All were quite dwarf in habit, with little foliage, bearing small ears, low on the stalks.

Stowell's Evergreen produced large ears of medium length, with small cobs, on stalks six or seven feet in height. The ears remained fit for boiling a long time, and when cooked were of excellent quality. The Early Eight-rowed produced ears from eight to ten inches long and two inches in diameter, on stalks six or seven feet in height, bearing abundant foliage. The Mammoth Sweet produced very large twelve or fourteen-rowed ears, seven to nine inches long, on stalks about seven feet high. In quality we considered this variety superior, being unusually sweet and tender.

The Ne Plus Ultra variety was very late, ripening no ears.

LETTUCE.

Seeds of ten varieties of lettuce were planted in the garden on soil prepared as for onions. The dates of planting, vegetation, etc., were as follows :

VARIETY.	Planted.	Vegetat'd.	Days.	Bloomed.	Days.	Seed ripe.	Days.
Boston Curled, . . .	April 18	May 2	14	July 28	101	Aug. 30	134
Hanson, ...	April 18	May 2	14	July 19	92	Sept. 4	139
All the Year Round, .	April 18	May 2	14	July 28	101	Sept. 6	141
Curled Simpson, . .	April 18	May 1	13	......	...	Sept. 6	141
Ice Drumhead, . . .	April 18	May 2	14	July 25	98	Sept. 4	139
White Cabbage, . .	April 18	May 2	14	July 24	97	Sept. 20	155
Brown Dutch, ...	April 18	May 2	14	......	...	Sept. 4	139
New Orleans Green Cabbage, ...	April 18	May 1	13	July 25	98	Sept. 20	155
White Cos, ...	May 6	May 19	13	July 28	83	Sept. 6	123
Early Tennis Ball, . .	May 6	May 19	13	July 28	83	Sept. 6	123

The New Orleans Green Cabbage and the White Cabbage varieties were very similar and are possibly identical. Seed stalks appeared slightly earlier on the latter and it vegetated one day later, but no further difference was discernible. The Brown Dutch, Curled Simpson and Hanson were noted as possessing superior flavor.

A few seeds of the Curled Simpson and White Cabbage varieties were also planted in the hot bed April 18, which vegetated April 21, and the plants were transplanted to the garden May 2 and 3. These were not, however, fit for use earlier than the same varieties planted in the open ground ; the shock of transplanting seeming to balance the earliness gained by forcing. Having plenty of room they developed into enormous heads, sometimes a foot in diameter, the inner leaves of which were blanched and continued sweet and tender a long time.

No especial difference was noticed in the earliness of the varieties, with the exception of the last two named, all being fit for use about June 10, though the length of time that the various sorts continued edible varied considerably. Thus, flower stalks appeared on the Boston Curled and Hanson June 30, and on the Ice Drumhead and White Cabbage July 5, on the Tennis Ball (planted May 6) July 6, and on the other varieties later, the dates not noted.

CELERY.

Seeds of Boson Market and Turner's Incomparable Dwarf White Celery were planted in the hot-bed April 13, the temperature of the soil being 92°. These vegetated April 24; the plants were pricked out June 1, and transplanted in the garden July 5, in trenches one foot deep, in the bottom of which was spaded in a liberal quantity of barnyard manure. The plants grew well during the summer, but in September were attacked by the celery worm, the larva of *Papilio Asterias*, one of our most beautiful butterflies which deposits its egg on the celery, parsnip and other umbelliferous plants during July and August. They also suffered somewhat from a sort of blight that attacked a

portion of the leaves, causing them to turn black and die. The Boston Market variety seemed to suffer most from these attacks; so much that the leaf-stalks grew scarcely more than six inches long, while those of the other variety attained double that length.

When the seed of Celery was sown in the hot-bed, a portion was covered with a thin layer of pulverized sphagnum (swamp moss) as an experiment. It was noticed that the portion so covered vegetated earlier, and produced a greater number of plants to the square foot than the part covered with soil only.

PEPPERS.

Thirty seeds each of eleven varieties of peppers were planted in the hot-bed April 6, the temperature of the soil being 90° F.

The plants that vegetated were transplanted May 29 to a well-fertilized garden plat, having a sunny exposure, and were cultivated with the hoe throughout the season, as often as the soil seemed to require it.

The varieties, number of seeds vegetated, and time of vegetation, blooming and maturity, so far as noted, will appear in the following table:

VARIETY.	Vegetat'd.	Days.	Bloomed.	Days.	Ripe.	Days.	Out of 30 seeds vegetated.
Red Cherry	Apr. 16	10	June 30	85	Sept. 6	153	19
Sweet Mountain	Apr. 14	8	July 3	88	Sept. 16	163	4
Oxheart	Apr. 14	8	July 6	91	Sept. 6	153	19
Large Bell or Bull Nose	Apr. 15	9	July 10	95	Sept. 6	153	10
Squash or Tomato Shap'd	Apr. 14	8	July 10	95	Oct. 5	182	9
New Cranberry	Apr. 15	9	July 12	97	Oct. 6	153	15
Long Red Cayenne	Apr. 13	7	July 14	99	Oct. 13	160	8
Long Yellow Cayenne	Apr. 15	9	July 17	102	Oct. 13	160	10
Sweet Spanish	Apr. 16	10	July 18	103	Oct. 13	160	10
Monstrous or Grossum	Apr. 14	8	July 26	111	Oct. 7	184	4
Small Red Chili			July 6	91	Sept. 6	153	10

The Sweet Mountain or Mammoth, and the Large Bell or Bull Nose rotted considerably on the plants before ripening. The Sweet Spanish also rotted slightly. The Sweet Spanish, and Squash or Tomato Shaped, ripened but a small proportion of their fruit. The Monstrous or Grossum was extremely late, not ripening a specimen of its fruit until October 7.

The pepper plant is extremely variable. The fruit on different plants of the same variety often varies much in shape. On one plant of the Long Yellow Cayenne variety the fruit was all borne erect, while on the others it was pendant. Certain plants of a variety often mature their fruit much earlier than others. Flowers on the same plant differ in the number of parts of the corrolla and the number of stamens, and the fruit in the number of its cells.

TOMATO.

Thirty seeds each of seven varieties of the tomato were planted in the hot-bed April 7, the temperature of the soil being 92 degrees The plants were removed to the garden May 29, in rows four feet. apart, the soil being well fertilized with baru-yard manure.

The varieties and statistics noted were as follows:

VARIETY.	Vegetated.	Days.	Bloomed.	Days.	Ripe.	Days.	Of 30 seeds vegetated.	Per cent of water by weight.	Per cent of seeds by weight.
Mayflower..........	Apr. 12	5	June 16	70	Aug. 8	123	8	93.2	.46
Early Acme........	" 12	5	" 20	74	" 10	125	18	93.1	.71
Trophy............	" 12	5	" 20	74	" 10	125	6	92.6	.70
Paragon	" 13	5	" 20	74	" 16	129	6	92.4	.56
Turk's Cap or Turban	" 12	5	" 20	74	" 18	123	....	92.6	.53
Red Cherry........	" 13	6	" 9	63	....	....	7	......	....
Yellow Cherry	" 12	5	" 15	69	....	....	16	... ..	....

The time of maturity of the red and yellow cherry varieties was not noted. It was, however, about a week earlier than that of the Mayflower. A few plants of two varieties were trained upon a trellis to discover the effect on the time of maturity. On plants of the Mayflower allowed to grow upon the ground the first fruit matured August 8, while on a plant trained upon a trellis the first fruit ripened August 16. A corresponding difference in the time of maturity was noticed in the Early Acme.

A few plants of the latter variety were pinched back shortly before the first fruit had ripened, and on a single plant the leaves were nearly all taken off to see if pruning would hasten the ripening. The fruit did not ripen earlier on these plants than on those not pruned.

August 7 a few specimens of the Early Acme and Mayflower were found to be affected with the tomato rot. The disease increased slowly until about the middle of the month, when it had also attacked the Paragon and Trophy varieties. For a few days following it increased with great rapidity, threatening to sweep away the entire crop on the varieties attacked. By September 1st, however, it had perceptibly abated, though it prevailed to some extent throughout the remainder of the season. It was most destructive in the Early Acme variety.

No traces of insect work could be found. The affected fruits showed neither marks of puncture nor larvæ. The symptoms of rot were first visible about the apex of the fruit, which assumed a somewhat lighter color than the remainder. Brown spots appeared, which rapidly increased in size, uniting with each other, and the whole structure of the fruit was quickly destroyed.

A few experiments were made with the view of discovering the nature of this disease, which is possibly allied with the potato rot.

August 28, four samples of sound fruit of the Early Acme variety were selected, and a small incision made in each near the apex. In two of these a bit of matter from a decayed fruit was inserted in the incision. September 1, decay had commenced in the two inoculated fruits, while the other two remained sound. Later examinations

showed that the inoculated fruits quickly decayed. The experiment was repeated with other specimens, the decaying matter being inserted at various points on the surface, always with the same result in the varieties attacked by the disease. In every instance the decay commenced at the inoculated point. On October 10, the two fruits that were incised August 28, but not inoculated, were still hanging on the plant ripe, but entirely sound, while no trace of the inoculated two could be found.

The Turk's Cap or Turban variety seemed proof against the decay, even when inoculated.

These facts suggest that the tomato rot may result from a constitutional weakness in certain varieties, rendering them subject to attack by a fungus which less improved varieties, like the Turk's Cap and Cherry tomatoes, are able to resist.

We were very favorably impressed with the Mayflower variety, which originated, in the summer of 1878, with Mr. F. H. Hosford, of Charlotte, Vt., from a claimed cross between the Early Acme and Lester's Perfected. The plants were very vigorous, continuing fresh and green until destroyed by frost. The fruit, which is of a bright, glossy, red color, ripened two days earlier, and was somewhat larger than that of the Early Acme. In form it is globular, slightly flattened and entirely smooth. The flesh is solid and unusually free from seeds (see table), and in flavor is equal to any of the others.

The Pea.

Our work with the pea was confined chiefly to a comparative test of thirty-one varieties. The soil, which was fall-plowed, received no manure. Previous to planting, it was cultivated thoroughly, after which it was pulverized and leveled with the smoothing-harrow and "plank-drag." The peas were distributed in single rows, four feet apart, the seeds three inches apart, covered two and a half inches deep. Accuracy was secured in the distance and depth of planting by the help of a simple instrument devised for the purpose. The taller varieties were well "bushed," and the weeds were kept down with the hoe.

The American Wonder and Extra Early Dwarf Tom Thumb varieties grew under somewhat different conditions from the others, being planted thirty-two days earlier, on soil manured and plowed in the spring. The distance and depth of planting were, however, the same.

The statistics noted appear in the following table:

VARIETY.	Vegetated.	Days.	Bloomed.	Days.	At edible maturity.	Days.	Ripe.	Days.	No. seeds planted.	No. seeds vegetated.	Per cent of seeds vegetated.	No. pods borne.	Weight of shelled peas.	Average yield of dry peas per plant.
Laxton Earliest of All	May 20	14	June 15	40	June 29	54	July 19	74	139	51	36.7	583	10.25 oz.	.201 oz.
Extra Early Alpha	" 18	12	" 17	42	" 30	55	" 19	74	143	62	43.5	555	26.75 "	.481 "
Extra Early Daniel O'Rourke	" 18	12	" 17	42	" 30	55	" 19	74	144	84	58.3	583	34.00 "	.404 "
Philadelphia Extra Early	" 18	12	" 17	42	" 30	55	" 18	73	144	103	71.5	797	41.94 "	.407 "
Thorburn's First and Best	" 18	12	" 17	42	" 30	55	" 17	72	144	105	72.9	702	41.69 "	.397 "
American Wonder (planted April 4)	April 29	25	" 7	64	" 22	79	" 13	100	200	124	62	.....	18.56 "	.158 "
Extra Early Dwarf Tom Thumb (do.)	" 27	28	" 7	64	July 6	93	" 19	106	100	89	89	.....	33.37 "	.375 "
McLean's Little Gem	" 20	14	" 19	44	" 2	57	" 17	72	139	69	49.6	563	31.25 "	.467 "
McLean's Blue Peter	" 18	12	" 17	42	..	..	" 19	74	144.	64	44.4	401	17.75 "	.277 "
Premium Gem	" 20	14	" 17	42	" 2	57	" 19	74	199	87	62.6	613	44.06 "	.506 "
William the First	" 18	12	" 17	42	" 2	57	" 22	77	143	41	21.6	468	28.81 "	.591 "
Kentish Invicta	" 18	12	" 17	42	" 2	57	" 19	74	144	67	46.5	822	41.50 "	.619 "
Laxton's Marvel	" 19	13	" 25	50	" 10	65	...	...	140	68	48.5	679	48.94 "	.720 "
Napoleon	" 18	12	" 21	46	" 10	65	" 26	81	144	102	70.8	1,515	61.75 "	.605 "
Eugenia	" 18	12	" 19	44	" 10	65	" 26	81	144	64	45.1	1,297	54.69 "	.854 "
Day's Early Sunrise	" 18	12	" 17	42	" 13	68	" 19	74	144	89	61.8	1,296	57.81 "	.648 "
Laxton's Prolific Long Pod	" 18	12	" 23	48	" 13	68	" 29	84	140	110	78.5	1,540	79.25 "	.721 "
Culverwell's Telegraph	" 18	12	" 25	50	" 13	68	" 29	84	140	52	37.1	470	36.19 "	.696 "
Champion of England	" 18	12	" 25	50	" 17	72	" 29	84	140	57	40.7	1,447	64.69 "	1.117 "
White Marrowfat	" 20	14	July 2	57	" 17	72	Aug. 8	89	144	81	56.2	1,425	92.31 "	1.140 "
Bishop's Long Pod	" 19	13	June 27	52	" 18	73	" 10	96*	139	81	58.2	1,086	54.69 "	.675 "
Tall Gray Sugar	" 18	12	" 30	55	" 18	73	" 16	102*	141	115	81.6	1,543	80.50 "	.700 "
Black Eyed Marrowfat	" 18	12	" 30	55	" 18	73	" 8	89	144	116	80.6	1,431	79.75 "	.687 "
Bishop's Dwarf Prolific	" 20	14	" 21	46	" 18	73	July 27	82	139	117	84.1	1,402	58.12 "	.497 "
McLean Advancer	" 20	14	" 22	47	" 19	74	" 29	84	143	72	50.3	1,801	79.19 "	1.100 "
Tall Sugar	" 18	12	" 25	53	" 19	74	Aug. 3	89	144	129	89.5	2,184	96.31 "	.747 "
Dwarf Gray Sugar	" 18	12	" 27	52	" 19	74	" 8	89	144	123	85.4	.....	....	....
Blue Imperial	" 18	12	" 25	50	" 19	74	" 16	102*	140	88	59.8	1,445	73.00 "	.880 "
Hair's Dwarf Green Marrow	" 19	13	" 28	53	" 20	75	July 29	84	144	40	27.8	754	41.75 "	1.044 "
British Queen	" 18	12	" 28	53	" 21	76	Aug. 8	89	144	66	45.8	1,815	61.56 "	.982 "
Wrinkled Sugar	" 18	12	" 28	53	" 29	79	" 11	97	140	85	25	945	42.69 "	1.220 "

* Date when picked for seed, ripe a few days earlier.

The results of the past season would lead us to recommend the American Wonder as an early pea both for market and garden culture. This variety is claimed to be a cross between McLean's Little Gem and Champion of England, produced by Mr. Charles Arnold of Canada. The plant is from six to ten inches high, erect, frequently branched at the base; foliage dark green; flower stems very short. The first blossom appears at about the sixth joint, but when the earlier pods are picked green later blossoms appear clear to the ground. The pods, about five to the plant, are two and a half inches long by five-eighths wide, containing from four to eight roundish slightly flattened pease, one-third of an inch in diameter. The ripe pease are light green or cream-colored, three-eighths of an inch in longest diameter, much wrinkled. In earliness it was surpassed by very few, and in quality by none. Owing to its extremely dwarf habit, the rows, planted but two feet apart, gave ample room for picking.

Of the later varieties none were so productive, considering the height of the plant, as Hair's Green Dwarf Marrow. It grows but two feet high, is stocky and much branched both at the bottom and above. On one plant we noted nine terminal shoots from a single seed. Ten plants in order averaged 32 pods to the plant. Pods three inches long by five-eighths wide, containing from five to seven oval, flattened, much compressed pease, five-twelfths of an inch long by half an inch wide. Ripe pease light green or cream-colored; three-eighths of an inch in longest diameter, flattened, much wrinkled. In our test this variety was bushed, but we think it sufficiently dwarf to thrive without bushing.

Of the latter tall-growing sorts none were more satisfactory than Champion of England and McLean's Advancer, both of which produce pease in great abundance and of excellent quality. Laxton's Marvel and Culverwell's Telegraph are remarkable for the length of their pods, which are from three to four inches long, and which contain eight or nine, and rarely ten and eleven pease. In our test they were not strikingly productive.

Our list included four varieties of the sugar or edible pod pease. The pods picked when quite young and cooked in the same manner as string beans make a palatable dish. The flavor is neither like that of the ordinary pea nor bean, and is perhaps slightly inferior to both, but as helping to form a variety they are quite acceptable.

While making examinations of the growing pease during June and July, the pea-weevil *Bruchus Pisi, L.* was often found concealed within the blossoms, and after the crop had ripened it appeared that a large proportion of the seeds were infested with this insect. In September the full-grown weevils were found crawling out of the packages of pease gathered for seed, and examination showed that the greater part of the larvæ had developed into perfect insects, many of which had emerged from their cells.

The pea-weevil is supposed to be a native of the United States, and appears to have been first noticed in Pennsylvania, whence it has gradually spread through the Middle and Eastern States. It is a small oval beetle, rather more than a tenth of an inch long, of a rusty black color. While the pods are young and tender the beetles deposit their tiny eggs singly in punctures upon their surfaces. This is done mostly during the night or in cloudy weather. The grubs, as soon as they

are hatched, penetrate the pod and bury themselves in the pease opposite to the puncture. The holes through which they pass are so small as to be scarcely perceptible and are soon closed by the expanding of the pod. The grub feeds upon the marrow of the pea, and arrives at its full size by the time the latter is ripe. It then bores a round hole from the hollow in the center of the pea to the skin, but the perfect insect does not always emerge from its cell until the following spring.

A small quantity of bi-sulphide of carbon was confined in a bottle containing some of the infested pease. The fumes of the liquid soon killed the insects, whether they had burst open their cells or not, and sound pease were found to germinate promptly, even after several days' confinement in the bottle with the liquid. It would be well if seedsmen and all who preserve pease for seed would take this precaution, and destroy these insects before they escape. Could there be concerted action in this work, the damage from this pest, which is now very great, might be in a large measure averted.

Our experiments showed that though pease that have been inhabited by the weevil will frequently germinate they rarely make strong and productive plants. In one test of fifteen seeds only two vegetated, and but one made a vigorous plant. In an experiment in germination with a larger number, 57·2 per cent of "buggy" pease germinated.

In connection with the germination of seeds one observation is worthy of note. On April 4 the work of planting a plat was interrupted by a light shower, so that it could not be completed until the next day. It was expected that those planted before the rain would vegetate earlier than the others. In fact, however, they vegetated a day later, and up to the time of blooming a great difference was perceptible in favor of those planted after the rain. A similar difference, though still more marked, was noticed in plantings of the cow pea. The work, after being commenced, was deferred for two days, during which time a heavy shower of rain fell. Those planted after the rain vegetated earlier than those planted before. In both cases the soil, previous to the rain, was dry and somewhat cloddy. No explanation is offered for this unexpected difference. It suggests that there are still important facts to be learned connected with the vegetation of seeds.

The numerous varieties of the pea, with their differing characteristics, form a striking illustration of the influence of selection and the power of the horticulturist to change the form and character of plants. Botanists agree that all the garden varieties belong to one species. But, as Mr. Darwin has well remarked, "If one of the tall sugar pease, with purple flowers, thin-skinned pods, of an extraordinary shape, including large, dark purple pease, grew wild by the side of the lowly Queen of the Dwarfs, with white flowers, grayish-green, rounded leaves, scimetar-like pods, containing oblong, smooth, pale-colored pease, which mature at a different season, or by the side of one of the gigantic sorts, like the Champion of England, with leaves of great size, pointed pods, and large, green, crumpled, almost cubical pease, all three kinds would be ranked as undisputably distinct species." In view of these marvelous changes that have been brought about by the effort of the horticulturist, it is hardly too much to hope that great improvements may yet be made. At present, no one variety possesses all the good qualities that are presented by the various indi-

vidual sorts. Thus, while the American Wonder is unexcelled in quality and dwarf habit, it was surpassed in earliness by Laxton's Earliest of All; in length of its pods by Laxton's Marvel; in the size of its pease by Hair's Dwarf Green Marrow, and in the proportion of double pods by Tom Thumb. The Tom Thumb is a model variety for family use, in its great productiveness and the long time that it produces pods fit for the table; but it is inferior in quality to the wrinkled pease, and is surpassed by many varieties in earliness, the length of its pods and the size of its pease. Other similar comparisons might be drawn, but these are sufficient. It will appear, on examination, that every stem that bears a single pod has an abortive point that is ready to be developed into a second pod when circumstances are propitious, and in the axil of almost every leaf is a bud, waiting only for strength to grow into a branch. In the dwarf varieties, which are in every way preferable to the taller ones, there should certainly be no reason why this strength may not be called forth. It will be a blessing both to the gardener and to the seedsman when the desirable qualities in the pea that are now distributed through a score or more varieties are combined in a half dozen early, medium and late sorts, so that we can afford to strike from the list a large number of varieties that possess only average merit.

The varieties of the pea do not self-cross, hence the characters are nearly constant. They may, however, be readily crossed artificially. This should give the more encouragement to the horticulturist, since, when the desired qualities are once secured, there is little danger of their being lost through admixture with inferior varieties.

Lentils.

A few seeds of lentils were planted in the garden May 30, which vegetated June 8, the plants blooming July 28. The plant bears a striking resemblance to that of vetches or tares, though the blossom more resembles that of alfalfa. The lentils, like the vetches and alfalfa, were attacked in the latter part of June by a blight that checked their development until the latter part of August, when a new growth took place. On August 31, the lentils were noted as being in blossom a second time, the first bloom having been destroyed by blight. The seed failed to ripen, with the exception of a few plants that were evidently of a distinct variety from the main planting.

Biennials Producing Seed the First Season.

Several plants, usually biennial, blossomed and bore seed from the spring planting in the Station garden. Whether these sports resulted from peculiarities of the season or from poorly-selected specimens for seed, or both, we do not know. It is obviously a variation in the wrong direction, and in every case such plants were nearly or quite worthless for the purposes intended. A few of the ripened seeds have been gathered for planting another season, simply to test the effect of this kind of selection, but it is scarcely expected that any improvement will be thus secured. The biennials that ripened seeds were of beets, Dewing's Improved Blood Turnip and Early Blood Turnip; of carrots, Half Long Luc and Long White, also Salsify and Scorzonera. A few other varieties bloomed, but too late to ripen seeds.

THE ORCHARD.

There are on the Station farm at present 695 apple, ninety-six peach, seventy-four pear, thirty-seven cherry and twenty-three plum trees.

The apple orchard contains spaces for 737 trees, but forty-two of these are vacant. Three hundred and eighty-one of the apple trees bore more or less fruit the past season. A heavy storm of wind about the middle of September blew off about half of the whole amount, and a large proportion of those left on the trees were small and deformed. Thirty barrels of merchantable apples were harvested, and 100 barrels of windfalls and culls were sold as cider apples. The varieties are chiefly Rhode Island Greening, Northern Spy and Baldwin.

As has already been stated, the trees were thoroughly pruned in the spring. In the latter part of April they were examined for the purpose of finding and destroying the apple-tree borer, *Saperda bivittata*, Say. The trees seemed to be suffering but little from this enemy. Of 286 trees examined April 24 but three seemed infested with borers, and but one of these was seriously injured. The young trees that had been set out to fill vacancies in the older orchard contained more borers than the trees in the younger orchard. In the latter part of June many of the trees were infested with great numbers of Aphides (plant-lice), causing the foliage to curl, and, in some cases, to die. Our experience in destroying this insect, as well as the Codling Moth, *Carpocapsa pomonella*, L. and the Tent Caterpillar, *Clisiocampa Americana*, is given under the subject of insecticides.

The trees were labeled, so far as the varieties could be identified, with labels cut from sheet zinc, and immersed for a few minutes in dilute hydrochloric acid to roughen their surfaces for writing with a lead pencil. They were tacked to the trunks of the trees, at a convenient height, with a small box-nail driven in half its length.

The fruit-buds of the peach trees were frozen in the spring, and not a blossom appeared. In the latter part of May the foliage was attacked by a disease which gave the leaves a whitish, blistered appearance, causing them to curl, and finally to assume a brown color, die and drop off. About the first of July many of the larger trees which suffered most were almost destitute of leaves, but about the middle of the month the foliage began to look fresher, and shortly after a new crop of leaves appeared. We regret that a busy season offered no opportunity to study this interesting disease. Should it appear in the future, we hope to gather as much information on the subject as careful observation and the microscope will reveal.

July 6 the trees were examined in search of the peach borer, *Aegeria exitiosa*, Say, but only a few trees were found to be infested.

Thirty-three of the pear trees bore fruit, chiefly of the Bartlett and Buffum varieties. Late in the summer the pear blight appeared, but was confined to a few trees. All branches dying from this cause were promptly removed and burned.

All of the cherry trees bore a moderate crop of fruit.

The plum trees are, with a single exception, in the poultry yard. The effect of poultry about the trees seemed very beneficial, by hindering the work of the Curiculio, *Conotrachelus nenuphar*. June 17 we examined 100 specimens of fruit at random on different trees in the

poultry yard, finding but three stung by this insect, while in the same number on the tree outside thirty-seven had been stung. Nearly all the trees within the poultry yard produced a good crop of fine plums, while the one outside bore but a few specimens.

HUCKLEBERRY.

It will hardly be denied that the huckleberry possesses better natural qualities than either the currant or gooseberry, yet the latter have been cultivated for centuries, while the former has received very little attention from horticulturists, few regarding it as even worthy of mention. The reasons for this neglect do not appear. We are unable to learn that sufficient effort has been made to improve this fruit to justify an opinion that its improvement is impossible. The history of our economic plants offers hope that this plant may yield, under proper culture, varieties superior to those found in the state of nature. Will the plant submit at all to the conditions of cultivation? Does it vary in its natural habitat? Can it be propagated from seeds? Will the flowers admit of cross-fertilization? These are interesting and important questions.

In answer to the first, we find little testimony. A correspondent of the New York *Tribune*, writing from Maine, not long ago, stated that he had grown the huckleberry in his garden for forty years, and that the plants bore finer fruit than those left in their wild state. A. S. Fuller says: "That the swamp huckleberry, *Vaccinium corymbosum*, will grow and produce fruit upon high and dry soils I have proved by experiment." Of eight full-grown plants of this species and *V. pennsylvanicum* transplanted to the Station garden last spring, five survived, one of which blossomed, but set no fruit.

The second question may be answered affirmatively. From correspondence the past season we learn that varieties of the huckleberry are sometimes found producing white, flesh-colored and carmine fruit. Mr. Fuller says the swamp blueberry, or high bush huckleberry, *V. corymbosum* "assumes various forms and colors; sometimes the fruit is oval, approaching oblong, while others are globular or slightly compressed." Dr. Gray also says this species "exhibits the greatest variety of forms." Our own observation has shown the seeds in different samples of fruit from the same species vary greatly in number. Analogy would say that if a plant varies this much in the state of nature, it will vary much more under cultivation.

In the third question we meet some discouragements. Prof. C. S. Sargent of the Arnold Arboretum has succeeded without difficulty in growing the plants from seed, but the latter require several months to germinate, and sometimes the young plants do not appear until the second year. These require careful treatment, and do not bear until from three to five years old. These facts may possibly account for the little interest the matter has received. Prof. Sargent thinks that the plants would fruit earlier if grafted at the age of two years upon old stocks. The plants may be propagated by budding, grafting and layering, performed in the usual manner.

It is said that the seeds should not be allowed to become dry before planting, and perhaps the best way to avoid this is to mash the berries

in fine sand in a box or flower-pot and bury the latter in the open ground until the time for planting. Prof. Sargent plants the seeds in the beginning of winter in a moderately warm green-house, and Mr. Fuller recommends planting in the spring in a bed, "the soil of which should be at least half leaf mold or peat from a swamp, the remainder, any good garden soil. Surround the bed with boards a foot or more in height, mix the soil thoroughly, rake level, and sow on the sand containing the seeds. Sift over this sufficient soil to cover the seeds about a quarter of an inch deep, give a good soaking of water and place a screen over the frame. It may be made of lath, coarse cloth, or any thing that will partially shade the plants when they come up, but not wholly exclude the light." We would add that a thin covering of fine swamp moss will aid in securing an even moisture in the bed. We think this subject worthy the attention of the amateur, and would suggest that those who live convenient to the habitat of the huckleberry not only make the experiment of growing the plants from seeds, but also try cultivating and fertilizing them in their native ground.

INSECTICIDES.

Our experience with the cabbage caterpiller, *Pieris rapæ*, L., Striped cucumber beetle, *Diabrotica vittati*, squash borer, *Ægeria cucurbitæ*, Harris, and pea weevil, *Bruchus pisi*, L., has already been noted. The potato beetle, *Doryphora decemlineatta*, Say, currant worm, *Hernatus ventricosus*, Klug, codling moth, *Carpocapsa pomonella*, L., tent caterpillar, *Clisiocampa Americana*, Harris, squash bug, *Coreus tristis*, De Gar, and the cabbage flea-beetle, *Haltica striolata*, also engaged our attention to some extent.

One per cent of Paris green thoroughly mixed with land plaster, dusted over the foliage of the potato, proved entirely efficacious in destroying the larvæ of the potato beetle, *Doryphora decemlineatta*, Say. We have reliable testimony that a still smaller proportion of the poison has answered equally well. Prof. Lazenby believes that a small amount of Paris green is surer than a larger, as the insect instinctively avoids a sensible quantity. There is no doubt that farmers have often greatly increased the expense and danger in using Paris green, by applying it in unnecessarily large quantities.

The mixture used for the potato bug also destroyed the currant worm, *Hematus ventricosus*. Slacked lime was efficacious when dusted directly upon the insect, but not otherwise. Nothing, however, was tried that seemed to possess any advantage over powdered White Hellebore for preventing the ravages of this insect.

June 29, the foliage of twenty apple-trees, chiefly of the Rhode Island Greening variety, was syringed with water containing Paris green at the rate of a heaped tablespoonful to a barrel, as an experiment in destroying the Codling moth, *Carpocapsa pomonella*, L.

The apples which grew on these trees were the fairest of the kind in the orchard, but were not entirely free from "wormy" specimens. The small apple crop of the past season makes the ravages of this insect more noticeable than usual, and comparatively few fair specimens of fruit were found in the Station orchard.

The above application had no visible effect in destroying the myriads of plant-lice (*aphides*) with which the leaves were infested at the time.

The Tent caterpillar, [*Clisiocampa*] *Americana*, was easily and

effectually destroyed by rubbing off the nests as fast as they appeared with a swab attached to a pole and saturated with spirits of turpentine.

August 26 the mixture of hard soap, kerosene oil and water used for the cabbage caterpillar applied to vines infested with the squash bug (*Coreus tristis*) produced no visible effect. A little Paris green added to the mixture, however, rendered it entirely efficacious. The mixture of Paris green and land plaster that was successful with the potato bug failed to destroy the cabbage flea-beetle (*Haltica striolata*), but water-slacked lime dusted over the plants was entirely successful.

The Flower Garden.

For the information of those who may desire to know the time of blooming of the more commonly cultivated flowering plants the following table is presented, showing the results obtained the past season in the Station flower garden. The cold and wet weather of spring retarded the growth of the plants considerably, and in consequence the period of bloom noted may be considered as somewhat later than usual.

The following were the plants grown from seed and from bulbs :

	Planted.	Vegetat'd.	Transplanted.	Bloomed.	Days.
Camellia-flowered Balsam,	April 8	April 17	May 25	June 26	79
Solferino Balsam.	April 8	April 17	May 25	June 26	79
President Thiers' Coxcomb (dwarf).	April 8	April 17	June 15	July 20	103
Tall coxcomb,	April 13	April 19	June 15	July 20	98
Double-flowering Sweet William,	April 8	April 17	June 15	....	.....
Dianthus Heddewegii,	April 8	April 16	June 5	July 5	88
Dianthus Hybridus,	April 8	April 21	June 5	July 5	88
Dianthus Barbatus (Sweet William),	April 13	April 19	May 31	....	.....
Dianthus Imperial,	April 13	April 17	June 5	July 10	88
White China Pink,	April 13	April 18	June 5	July 10	88
Phlox Drummondii,	April 8	April 19	May 25	June 29	82
Ten Weeks' Stock,	April 8	April 16	May 29	June 26	79
Petunia,	April 13	April 19	May 25	June 27	75
Zinnia,	April 13	April 16	May 31	June 15	63
Pansy,	April 13	April 21	June 5	June 27	75
Hollyhock,	April 13	April 17	May 31	Aug. 16	125
Aster, Dwarf Boquet,	May 1	May 6	June 5	Aug. 3	95
Pot Marigold,	May 1	May 6	June 5	July 6	67
African Marigold,	May 1	May 6	May 31	June 29	60
Portulacca,	May 19	June 5	....	July 4	46
Sweet Pea,	April 15	May 9	....	July 4	80
Candytuft, White,	May 19	June 1	....	July 6	48
Candytuft, Rose,	May 19	June 3	....	July 21	63
Candytuft, Crimson,	May 19	June 5	....	July 21	63
Nasturtium, Tall,	May 19	June 3	....	July 13	55
Larkspur, White,	May 19	....	....	July 6	48
Larkspur, Rocket,	May 19	....	....	July 29	71
Picotee,	May 19	June 6	....	....	.....
Nigella Damascena,	May 19	June 6	....	July 30	72
Convolvulus Major,	May 19	June 3	....	July 30	72
Calendrina Discolor,	May 19	....	....	Aug. 4	77
Gaillardia Picta,	May 19	June 9	....	Aug. 9	82
Sunflower, Dwarf Double,	May 19	June 1	....	Aug. 3	76
Eschscholtzia Californica,	May 19	June 5	....	July 17	59
White Crysanthemum,	May 19	June 1	....	July 18	60
Venidium Calendulaceum,	May 19	June 1	....	July 18	60
Mirabilis Jalappa,	May 22	June 6	....	July 31	70
Ricinus,	....	June 6	....	Aug. 14	78
Gladiolus,	May 19	June 3	....	Aug. 5	.....
Tigridia,	May 19	June 9	....	Sept. 6	110

or flower-pot and bury the latter in the o
for planting. Prof. Sargent plants the seed
in a moderately warm green-house, and
planting in the spring in a bed, "the soil of w
leaf mold or peat from a swamp, the remai
Surround the bed with boards a foot o
thoroughly, rake level, and sow on th
Sift over this sufficient soil to cover the se
deep, give a good soaking of water and plac
may be made of lath, coarse cloth, or
shade the plants when they come up, but
We would add that a thin covering of
securing an even moisture in the bed. W
attention of the amateur, and would
convenient to the habitat of the huckle
ment of growing the plants from seed
fertilizing them in their native ground.

INSECTICIDES.

ence with the cabbage caterpiller, *Pieris*
eetle, *Diabrotica viltati*, squash borer,
pea weevil, *Bruchus pisi*, L., has al
beetle, *Doryphora decemlineatta*, Say, cu
ricosus, Klug, codling moth, *Carpoca*
pillar, *Clisiocampa Americana*, Harris,
Gar, and the cabbage flea-beetle, *Ha*
ur attention to some extent.
cent of Paris green thoroughly mixe
er the foliage of the potato, proved
g the larvæ of the potato beetle, *Dor*
e have reliable testimony that a still sm
has answered equally well. Prof. Lazen
of Paris green is surer than a larger, a
a sensible quantity. There is no doubt
increased the expense and danger in u
it in unnecessarily large quantities.
e mixture used for the potato bug a
Hematus ventricosus. Slacked lim
ed directly upon the insect, but not o
was tried that seemed to possess any
te Hellebore for preventing the ravages
une 29, the foliage of twenty apple-tr
nd Greening variety, was syringed wi
en at the rate of a heaped tablespoonfu
nt in destroyi g moth, C
The apples w these
the orchard.
e small ap
sect more
ens of fr
The ab
plant-
The T

effectually destro...
with a swab attac...
August 26 the ...
for the cabbage ...
bug (*Coreus tristis* ...
added to the mixt...
mixture of Paris gre...
potato bug failed to ...
but water-slacked lime ...

For the inform...
blooming of the ...
lowing table is ...
in the Station ...
tarded the growth ...
period of bloom ...
usual.
The follo...

Camellia-...	
Solferino ...	
President ...	
Tall coxcom...	
Double-flo...	
Dianthus ...	
Dianthus ...	
Dianthus ...	
Dianthus ...	
White ...	
Phlox ...	
Ten ...	
P...	
Zi...	
P...	
H...	

... e
... to-
... ires,
... oduc-
... ned to
... the net
... it to pur-
... surprising
... eager with
... ey were able
... tice may have
... later years it
... mes proved dis-
... ver.
... the Department of

	Pounds.
....	11,800,000
....	10,000,000
....	8,700,000
....	12,000,000
....	8,500,000
....	2,500,000
....	2,500,000
....	3,000,000
....	3,000,000
....	1,600,000
....	2,750,000
....	1,500,000
....	....
....	2,200,000
....	2,400,000
....	6,600,000

...roduced in New York, judged from the ...arket, is about the same as that produced ...to that grown in the Connecticut valley. ...seventeen years previous to 1880 was, in ...pound; in Pennsylvania 13.5 cents per ...22.1 cents per pound. The highest average ...r New York seed-leaf was in 1864, 24 cents ...1876, 8.4 cents. Thirty cents per pound has ...good crops, both in the Chemung and Onon-

...the only varieties grown were the different ...ut seed-leaf. Since 1878, however, the Domes-...rown with excellent success in the Onondaga ...rids between the Connecticut Seed-leaf and ...y cultivated in this region, and the product is

The Sweet William and Picotee Pinks are perennials and do not bloom the first season. Those noted as having been "transplanted" were started in the hot-bed.

All the annuals, with the exception of the Aster, Sunflower and Gladiolus, continued in flower until October 10, when the Balsams, Coxcombs, Mirabilis, Portulaccas and Nasturtiums were destroyed by frost. The others continued their brilliancy a week longer, when they were removed for the purpose of forking over the beds. The soil of the flower garden had previously been devoted to nursery purposes and was not in good condition for flowers. The freshness and persistency of the bloom were, however, a matter of frequent remark, and were undoubtedly due to a liberal application of fertilizer to the soil, showing that flowers appreciate fertility as well as farm crops.

A few roots of the Water Lily (*Nymphæa odorata*) were procured from a pond March 28, the roots were planted in a tub containing a few inches of rich soil and the tub set in the ground its full depth and kept filled with water. July 18 two flower buds appeared which opened a week later in all their beauty and fragrance, and were followed in a few days by two others. Late in autumn the tub was taken up and removed to the cellar.

The earliest flower of spring was the beautiful and fragrant sweet Violet (*Viola odorata*), which bloomed on the lawn April 3, continuing in blossom several weeks. The dwarf garden Iris (*Iris pumila*), also bloomed on the lawn April 29.

TOBACCO.

In two sections of our State tobacco is a leading farm crop. The one lies chiefly within the valley of the Oswego river, embracing northern Onondaga, southern Oswego and Cayuga counties; the other is mostly in the valley of the Chemung river, and includes portions of Chemung, Steuben and Tioga counties.

The importance this crop has assumed in these sections is, perhaps, scarcely appreciated in parts of the State where tobacco, as a farm product, is unknown. Districts may be found, lying within the boundaries named, in which the income from the tobacco crop during the last two decades far exceeds that from all other farm products combined.

Tobacco was cultivated in New York as early as 1646, and may have been grown in small quantities in some parts of the State ever since that time. The pioneers of the Chemung valley grew tobacco for their own consumption, and we find in a pamphlet descriptive of "The Genesee Country," published in 1804, by Robert Munro: "Tobacco is raised of a good quality, but as yet not in large quantities." It was not until almost two centuries after the settlements in New York that the tobacco product seems to have assumed any commercial importance. We learn from a report of the Department of Agriculture that 744 pounds were produced in our State in 1840. The first field crop of which we find record was grown by Mr. Chester Moses, in Marcellus township, Onondaga county, in 1845. Six years later, in 1851, Mr. Sanford Elmer grew a field of six acres in the town of Big Flats, Chemung county, supposed to have been the first field crop grown in southern New York. From these small beginnings the production

seems to have increased with accelerating speed until the close of the rebellion. From the authority just mentioned we learn that in 1850 the New York crop reached 83,000 pounds, which swelled to 5,700,000 pounds in 1860, and by 1864 reached the enormous maximum of 13,-000,000 pounds. With the breaking out of the war the prices of tobacco suddenly advanced to double and even triple their former figures, which readily accounts for the unprecedented increase in the production between 1860 and 1864. Farmers who had been accustomed to live by the slow but sure profits of grain and butter found that the net proceeds of a single acre of tobacco were often doubly sufficient to purchase the land on which the crop grew. It is hence not surprising that tobacco growing made rapid headway, and that many, eager with the prospects of wealth, devoted larger areas to it than they were able properly to fertilize or care for. This too common practice may have been profitable in the panicy markets of war-time. In later years it has usually disappointed expectations, and has sometimes proved disastrous to the cautious as well as to the reckless grower.

From 1865 to 1880 the production reported by the Department of Agriculture is approximately as follows:

In	Pounds.
1865	11,800,000
1866	10,000,000
1867	8,700,000
1868	12,000,000
1869	8,500,000
1870	2,500,000
1871	2,500,000
1872	3,000,000
1873	3,000,000
1874	1,600,000
1875	2,750,000
1876	1,500,000
1877	....
1878	2,200,000
1879	2,400,000
1880	6,600,000

The quality of the tobacco produced in New York, judged from the prices it has commanded in market, is about the same as that produced in Pennsylvania, but inferior to that grown in the Connecticut valley. Thus the average price for seventeen years previous to 1880 was, in New York, 13.6 cents per pound; in Pennsylvania 13.5 cents per pound, and in Connecticut 22.1 cents per pound. The highest average price that has been paid for New York seed-leaf was in 1864, 24 cents per pound; the lowest in 1876, 8.4 cents. Thirty cents per pound has sometimes been paid for good crops, both in the Chemung and Onondaga districts.

Until quite recently the only varieties grown were the different strains of the Connecticut seed-leaf. Since 1878, however, the Domestic Havana has been grown with excellent success in the Onondaga districts. Several Hybrids between the Connecticut Seed-leaf and Havana are extensively cultivated in this region, and the product is

considered superior in quality to that of the Connecticut varieties; so much so that the latter are at present but little grown. The Havana hybrids are being rapidly introduced in the Chemung districts also.

The soil on which the greater part of the tobacco is grown is clay or gravel loam, fertilized with stable or barn-yard manure. The crop has generally proved profitable to those farmers who have not planted larger areas than they were able to manure and cultivate well, and prepare the crop for market in the best manner. Perhaps no crop grown in our State gives better rewards for careful management than tobacco.

The business has not, however, been without its drawbacks. Hail storms have often been very disastrous, and heavy falls of snow, or tornadoes, have often broken down the buildings in which the crop is cured, causing almost total loss to the crops within them.

These drawbacks have not, however, been more serious with the tobacco crop than is to be expected with any special crop that requires an equally long preparation for market.

We acknowledge our indebtedness to Mr. J. F. Green of the Baldwinsville *Gazette*, for facts relating to the history of tobacco growing in Onondaga and adjacent counties.

A few experiments were made on a small scale with tobacco, embracing chiefly distances of planting, methods of cultivation and varieties. It was not expected that our results could be conclusive, though it was hoped that they might be suggestive. A quantity of tobacco seed, catalogued and labeled as fifteen distinct varieties, was purchased of one of our leading seedsmen with the view of testing the adaptability of these varieties to the soil and climate of New York. These seeds, with five varieties obtained from other sources, were planted in the cold frame April 12 and 13, having been previously "put to sprout" between layers of cotton cloth. Of five of these fifteen so-called varieties, very few seeds sprouted and these proved so feeble that they never produced plants. All of the others, however, vegetated more or less plants. A few plants of each of the fifteen varieties that vegetated were set out June 8, on a piece of ground prepared for the purpose. But the purchased seed proved to be a shameful mixture of perhaps half a dozen different sorts. In a single group, the plants were all of one variety, and undoubtedly true to name, viz.: the Turkish tobacco. Another group, from seed labeled Latakia, contained one plant that could be identified as correct, but the other groups illustrated so much mixture that the labels were passed by as useless, and although they contained several distinct varieties, these could not be identified by any description at hand. A bit of mosquito netting was tied around a branchlet on each plant that appeared distinct, to preserve pure a portion of the seed for planting another year, when further attempts will be made to name and study varieties.

It is proposed to plant for a term of years a small quantity of the seed of as many of the varieties not yet tested in the north as can be procured, sowing each year the seed of the previous year, to discover the effect of acclimation on their qualities.

Two of the varities tested, viz.: the Turkish and Latakia, belong to the species *Nicotiana rustica,* and are quite distinct from the varieties

common in this country, all of which seem to belong to the species *N. tabacum*. The leaves of the former species are much smaller than those of our varieties, are produced on long petioles, and are deeper colored, more glossy, thicker and more succulent. The flowers are numerous, greenish-yellow, and nearly entire on the borders ; the seed vessels are smaller and more nearly round than those of our common varieties. The Turkish tobacco is much earlier than our common sorts. It blossomed twelve days earlier than any other variety, and the seeds were nearly ripe before some kinds had opened their flowers. While it possesses no qualities that would recommend it for cultivation where the Connecticut seed-leaf can be grown, it has been suggested that earlier varieties of the latter might be produced by hybridizing with it. An attempt was made to hybridize the two species, but out of about fifty attempts only one hybridized flower produced a seed vessel. The seed from this will be planted and the result noted another season.

In starting plants, three experiments were made:

1st. A seed-bed was prepared by placing a layer of pulverized sphagnum (swamp moss) three-fourths of an inch below the surface, the soil above and below being fine, rich mold. The roots of plants grown in a bed thus prepared appeared no different from those of others grown in the ordinary manner, nor could it be seen that such plants endured transplanting any better.

2d. The seeds were covered with a thin layer of pulverized sphagnum. This was found to be beneficial. Boxes covered in this way produced a larger proportion of good plants from the same amount of seed than others not so treated. The moss apparently retarded evaporation and sheltered the young plants from the direct rays of the sun. It would seem that this method might be practiced with profit by the tobacco grower.

3d. A few hundred plants were "pricked out" when the leaves were about the size of the thumb nail, as practiced by market gardeners with cabbage, tomato and other plants. These very soon recovered from the effects of the removal, and made fine, stocky plants. They were transplanted to the field June 14 and 15, with others of the same sowing that had not been pricked out. Soaking rains followed, and after a few days no difference could be seen in the plants treated by the two methods.

A second trial, under less favorable conditions, showed some advantage in favor of the "pricked out" plants, though less than was expected.

The variety grown for the experiments in cultivation, etc., was the "Brand," a local name applied in Southern New York, to a very prolific strain of the Connecticut seed-leaf, found in cultivation in Lancaster county, Pa., by the late John Brand, of Elmira, N. Y. We have been able to gather nothing authentic concerning its original name or history. It is characterized by long, broad, pointed leaves, of a deep green color, and somewhat drooping while growing; when cured, rather thick, but oily, and of excellent quality.

The following experiment was made, to ascertain whether barn-yard manure is more beneficial on the surface than when plowed under, the assumption being that tobacco, which by nature is a tropical plant,

roots chiefly on the warmer soil near the surface: Three adjoining plats of equal size were selected. No. 1 was manured on the surface after the ground was prepared for setting, at the rate of fifteen large wagon-loads of barn-yard manure per acre. No. 2 was manured with the same amount before the ground was plowed, and No. 3 was left unmanured. The plant in plat No. 1 averaged in weight (green), 38·42 ounces; in No. 2, 31·42 ounces, and in No. 3, 38·02 ounces.

No attempt is made to reconcile the apparent inconsistency that plat 2, with a liberal dressing of well-rotted manure plowed under, should produce lighter crop than plat 3, which received no manure. It is an example of the difficulties that are constantly encountered in plat work. A lack of vigor was noticed in No. 2 quite early in the season, which became more apparent as the crop approached maturity. To ascertain whether the manure beneath the surface in plat No. 2 had the effect to entice the roots downward into the cooler soil, and thus retarding growth, the roots of the plant in each of the three plats were washed out, with the help of a garden engine, and examined. In depth, no difference could be seen. In plat No. 2 the roots were almost entirely above the manure. In all cases they were very shallow, seeming to be more in search of warmth than moisture.

To ascertain the effect of extremes in cultivation, three rows were grown without cultivation except such as was necessary to keep down weeds, and three adjoining rows were cultivated severely, forking the soil between the rows deeply and often. Where no cultivation was given the plants averaged in weight (green), 37·11 ozs., and where the excessive cultivation was given 32·2 ozs.

Strange to say, the soil where the excessive cultivation was given was found to be filled throughout with a dense network of fibrous roots, while that left without cultivation contained but few fibrous roots, and these were found chiefly in the center of the spaces between the rows where the soil was exposed to the sunlight. It was noticed also where the ordinary cultivation was given that the fibrous roots were more numerous in the open spaces between the rows. These observations suggest two deductions: that stirring the soil stimulates rather than retards the growth of fibrous roots, and that these roots are more attracted by warmth than fertility. The latter also suggests the advisability of planting tobacco in rows running north and south rather than east and west, to allow the largest opportunity for the sun to shine upon the soil between the plants.

It may be added that the excessive cultivation did not seem to hasten the development of the flower stalk; also that the deepest root of the tobacco plant could be traced but twenty-two inches below the surface, a depth materially less than that reached by the deepest roots of corn, wheat, oats, barley or potatoes.

To ascertain the effect of different distances in planting tobacco, on the yield and quality, five rows were planted as follows: No. 1 was five feet from its neighbors; and the plants three feet apart in the row; No. 2 was four and a half feet from its neighbors, with the plants two and a half feet apart in the row; No. 3 four feet distant with the plants two feet apart; No. 4 three and a half feet distant with the plants one and a half feet apart; No. 5 three feet distant with the plants one foot apart. The plants in No. 1 averaged in weight (green) 51·12 ozs., No. 2, 50·9 ozs., No. 3, 48·74 ozs., No. 4, 43·21 ozs., No.

5, 25·26 ozs. The weights cured were as follows: No. 1, 5·19 ozs., No. 2, 4·91 ozs., No. 3, 4·46 ozs., No. 4, 3·82 ozs., No. 5, 2·11 ozs.

Caculating the yields of the different rows per acre, row No. 1 represents 2940 plants or 943 lbs. of cured tobacco; No. 2, 3872 plants or 1188 lbs.; No. 3, 5445 plants or 1518 lbs.; No. 4, 8249 plants or 1981 lbs., and No. 5, 14,520 plants or 1915 lbs.

The quality of the tobacco from all of these rows was good, and little difference was noticed in the texture of the leaf except in row No. 5, in which it was perceptibly finer than in the other rows.

To ascertain the effect of "priming" tobacco (breaking off two or three of the lower leaves at or before the time of topping), two rows were selected and every alternate plant in each primed. The plants that were primed averaged in weight (green) 28·17 ozs., and those not primed averaged 33·1 ozs. The cured leaves from the primed plants averaged 2·74 ozs. per plant, or 9·72 per cent of the weight of the green plants, and from the plants not primed 2·53 ozs., or 7·64 per cent of the weight of the green plants. The cured leaf in both these lots was rather dry when weighed.

To ascertain the effect of different fertilizers on the burning qualities of tobacco, a few plants were fertilized with an excessive quantity of four different minerals and manures, viz.: sulphate of iron, sulphate of potash, land plaster and lime.

The burning quality of the leaf from plants treated with all these substances was good with the exception of that grown where the sulphate of potash was applied, in which it was decidedly poor; that is, the leaf yielded a dark colored ash. This effect was probably due to the excessive quantity applied, as potash in moderate quantity has been ascertained to be the essential element for producing good burning quality, and where all of these minerals were applied the soil probably contained sufficient potash for all the requirements of the tobacco plant.

It has been claimed that the method of hanging tobacco in the curing house by splitting the stalk with the spear and inserting through it a lath, has the effect to diminish the weight of the cured leaf. In order to test the correctness of this claim 100 plants were weighed while green in two lots of fifty each. One lot was hung on the laths, splitting the stalk as with the spear, and the other was hung with twine.

The cured leaf from the plants hung on the lath weighed 9·28 per cent of the green plants, and that from those hung with twine weighed 10·34 per cent of the green plants, indicating in this experiment a loss in the plants hung on the lath of 1·06 per cent.

The following experiment was made to ascertain the effect of early or late topping on the growth of leaf in the tobacco plant.

On the fifth of August two plants were selected of the Brand variety, growing side by side, and which had made, as far as could be seen, equal development. In both plants the flower-stalk had just appeared above the leaves.

Plant No. 1 was topped at a point that would be considered ordinary height. A string was tied around the stem of plant No. 2, at a point exactly corresponding to that at which No. 1 was topped. The length of the five upper leaves on plant No. 1 was then measured and that of the corresponding five leaves on plant No. 2. Other measurements were

taken of the same leaves from time to time, as noted below, and the average per cent of gain for the five leaves on each plant was noted.

The result is as follows :

Aug.	5.	Average length of leaves on plant No. 1	14·9 in.
Aug.	5.	Average length of leaves on plant No. 2........	13·825 in.
Aug.	8.	Per cent of gain, plant No. 1..................	15·7+ in.
Aug.	8.	Per cent of gain, plant No. 2....	20·4 in.
Aug.	15.	Per cent of gain, plant No. 1............	47·4— in.
Aug.	15.	Per cent of gain, plant No. 2.	40·1 in.

Plant No. 2 was topped August 15 at the point where the string was tied around the stem. A majority of the flowers had by this time opened. On August 27 the per cent of gain on plant No. 1 was 89·98 and on plant No. 2 was 72·56, showing a gain in favor of the early topped plant in the upper five leaves of 17·42 per cent. The gain was most marked in the uppermost leaf, and diminished regularly downward to the fifth, which was as far as was measured.

August 25, plant No. 1 had all the appearance of ripeness, while the upper leaves on plant No. 2 were both thinner and greener than on plant No. 1.

The plants that made the most rapid growth attained the largest size. Thus, fifty plants that were ready for topping August 5, averaged in weight, green, 52·065 ounces, and the cured leaves averaged 4·99 ounces per plant; thirty-two plants topped August 12 averaged 4·53 ounces green, the cured leaves 4·26 ounces, and sixteen plants topped August 19, averaged, green, 41·46 ounces and the cured leaves 3·66 ounces per plant. These plants were all harvested September 1.

It also appears that the weight the leaves retain when cured depends somewhat upon the time the plants are left standing after being topped. Thus in plants topped August 5, the cured leaves weighed 9·59 per cent of the green plant, in those topped August 12, 9·04 per cent, and in those topped August 19, 8·83 per cent.

These facts indicate the importance of early topping, of setting strong and vigorous plants, that will mature quickly, and of early planting in order that the danger of frost may not hasten the harvesting of the crop.

INDEX.

SECOND ANNUAL REPORT

OF THE

BOARD OF CONTROL

OF THE

New York Agricultural Experiment Station

For the Year 1883,

WITH THE REPORTS OF THE DIRECTOR AND OFFICERS.

TRANSMITTED TO THE LEGISLATURE, JANUARY 17, 1884.

ALBANY:
WEED, PARSONS & COMPANY, PRINTERS.
1884.

SECOND ANNUAL REPORT

OF THE

BOARD OF CONTROL

OF THE

New York Agricultural Experiment Station

For the Year 1883,

WITH THE REPORTS OF THE DIRECTOR AND OFFICERS.

TRANSMITTED TO THE LEGISLATURE JANUARY 17, 1884.

ALBANY, N. Y.:
WEED, PARSONS & COMPANY, PRINTERS.
1884.

1883.

ORGANIZATION OF THE STATION.

BOARD OF CONTROL.

GOVERNOR CLEVELAND, ALBANY, N. Y.
ROBERT J. SWAN, PRESIDENT, GENEVA, Ontario Co., N. Y.
GEN. N. M. CURTIS, SEC., OGDENSB'G, St. Lawrence Co., N. Y.
PATRICK BARRY, ROCHESTER, Monroe Co., N. Y.
W. A. ARMSTRONG, ELMIRA, Chemung Co., N. Y.
JAMES McCANN, ELMIRA, Chemung Co., N. Y.
JOHN O'DONNELL, JAMAICA, Queens Co., N. Y.
DANIEL BATCHELOR, UTICA, Oneida Co., N. Y.
J. S. WOODWARD, LOCKPORT, Niagara Co., N. Y.
A. V. MEKEEL, NORTH HECTOR, Schuyler Co., N. Y.

Director.
E. LEWIS STURTEVANT, A. M., M. D.

Assistant.
HENRY H. WING, B. Agr.

Horticulturist.
EMMETT S. GOFF.

Assistant Horticulturist.
A. B. LOVETT.

Chemist.
S. MOULTON BABCOCK, A. M., Ph. D.

Stenographer.
ROBERT WATSON.

STATE OF NEW YORK.

No. 33

IN ASSEMBLY,

JANUARY 17, 1884.

REPORT

OF THE BOARD OF CONTROL OF THE NEW YORK AGRICULTURAL EXPERIMENT STATION.

To the Honorable the Legislature of the State of New York :

During the past year work at the experiment station has been mainly a continuation of plans fully outlined in the report of the director of the station for the previous year.

The board of control has held frequent meetings at the farm and inspected with much care the field-work, and particularly plans submitted by the director, whose report we have the honor to submit, and to which reference is made for such specific information as may be desired to give full understanding of the character and extent of experimental work conducted at the station.

In accordance with the very common desire manifested by farmers throughout the State, many practical field experiments have been instituted and conducted to conclusions so far as the tests of a single year are concerned. It will be understood, however, that these experiments for the most part are such as require repetition through a long series of years to eliminate possible errors dependent upon conditions of the season, or cultivation, or other influences that cannot possibly be determined without repeated tests.

In these field experiments farmers throughout the State have immediate concern; if conducted to safe conclusions abundantly proved by trial, they will be of immense value to the agriculture of the State.

The habit of referring questions to the station by farmers who wish to have careful and scientific investigation of the matters presented. has within the past year been greatly extended; thus insects that attack fruits, grains, seeds, grasses, and the roots of plants have been in greater or less degree subjected to examination at the request of farmers whose interest has been excited by desire to provide ways for their destruction. In this labor the station must necessarily have increasing importance, suggesting the propriety of giving it fuller equipment for the special work in various departments of scientific investigation

by which farmers seek precise information regarding problems which they are not of their own means able to solve. In this way we believe that the station may soon return to the agriculture of this State benefits vastly beyond the cost of its maintenance.

Respectfully submitted,

ROBERT J. SWAN,
President.

N. M. CURTIS,
Secretary.

TREASURER'S REPORT.

GENEVA, N. Y., *January* 15, 1884.

To the Honorable the Legislature of the State of New York:

As treasurer of the board of control of the New York Agricultural Experiment Station, I have received for the year ending with October 31, 1883, checks from the Treasurer of the State of New York, amounting to $18,000. I have expended during the year ending with October 31, 1883, $15,847.75, vouchers for which, duly audited by the special auditing committee of the board of control, have been furnished the Comptroller of the State of New York.

Properly classified, the expenditures have been as follows:

Permanent improvements	$1,702 54
Labor	3,326 00
Salaries	6,744 46
Live stock	551 70
Running expenses, including seeds, stable supplies, coal, oil, postage, express, freight, printing, stationery, stakes, labels, etc	3,523 05
	$15,847 75
There has also been expended by the Comptroller for traveling expenses of the board of control, to October 31, 1883	854 86
Making total expenses	$16,702 61

ROBERT J. SWAN,
Treasurer.

PRELIMINARY REMARKS.

To the Board of Control of the New York Agricultural Experiment Station:

GENTLEMEN — I herewith present my second annual report, embracing the period included within the year 1883.

The year, upon the whole, has been a favorable one, despite some damages which occurred to crops in the garden from the excessive rain-fall. As the object of the station work is rather to discover the whys and the wherefores than to raise crops, it is to be hoped that failures may be at times as instructive as successes, and certain it is that the success of our work is not to be measured by the crops raised, but rather from the information secured and rendered available for practice.

Your director would call attention again to his interpretation of the duties required of his office. The object of the station is to discover, verify and disseminate. In order to accomplish this purpose it is necessary that the work should be varied, according to its character, so as to accomplish results in a speedy, certain and accurate manner. For the purpose of discovery, clues to direct our research must first be obtained, and then wisely planned trials and close observation must take their part. It is in this line of investigation that the littles assume such large importance, and where matters which at first thought appear trivial, as study proceeds, fall into line, and tend to explain and suggest practices which must in the end be deemed of practical concern to the farmer. To discover even one empirical law, and to succeed in tracing out its relations to known facts would be a success indeed, and how much greater the success if the relativity of the laws bearing upon agricultural pursuits were clearly traced and sharply outlined, so as to be made available to the worker in the barn or field. Facts are oftentimes local, but the law which gives expression to these facts is general, and in so far as the station work deals with principles, it ceases to be local. If the hoped-for results are acquired through our effort to generalize and formulate the facts as apprehended, then the discoveries it may perchance be our privilege to make, under this interpretation, may be found as serviceable elsewhere as here.

Verification, as an object for station effort, seems fully as important as discovery. Agricultural knowledge, so called, is too often pseudo-knowledge. If there is a science which can be called agricultural, then it must be able to endure the criticisms to which other and better defined sciences are exposed. If in agriculture a truth be claimed, then this claim must be subject to the test of verification, and if it

fails to respond to the test, then its title to acceptance must be invalid. Agriculture, in its practice, is a complex art; it deals with factors of varied character, and great divergency. Under the concrete terms of seed, soil, fertility, climate, protection, etc., we express the combined results of also varied and divergent factors. Were it possible to give expression to the values of each and all of these factors, not only by themselves, but in their relations, then we could hope to have an exact science, admitting of definite expression, admitting of verification, admitting of duplication in experimental trials. It seems to me that a thoughtful consideration of the principles involved in this idea must give hope that progress can be made, and that sooner or later the results of a careful study into the principles and relations governing agricultural pursuits will enable tables of constants to be established which shall avail to interpret for us the discrepancies now so familiar to practice, and will enable us to secure with accuracy the results for which we may plan. If a practice be claimed as successful, then should we be able by trial to verify its claims, eliminating the effect of local conditions, and getting an understanding of the truth or falsity of the principles upon which the claim may be founded. An illustration may be sought in the potato. Some observers claim that hilling is preferable for crop; others assert with equal confidence the claims to level culture. Any verification of these claims becomes impossible, because founded upon local conditions alone, and whatever the results of a trial the question will yet remain unsettled for a different soil or a different climate. If, however, we go behind processes to seek the causes, we then have a true subject for investigation, and our conclusions, if correct, admit of verification and allow of generalization into formulæ which may become accepted with confidence by the farmer.

What are the relations of the process of planting to soil and climate? What do we effect thereby to influence the growth habit of the plant? Can similar conditions, procured in other or divergent ways, procure like results? By seeking verification to suppositions like these, and by clearly apprehending the value of the plant and the conditions, we may hope in time to determine with accuracy the conditions required, and to furnish proof of accuracy by the gaining of equivalent results through successful trials.

There is another kind of verification, however, which is deserving of notice. This kind is general in its nature, and gives reply in terms of greater or less, rather than in accurate numbers. Thus for illustration, in our report for 1882, we put forward the results of some trials with corn, in order to determine whether the position of the kernel on the cob had an influence on growth and crop. This year we devised a series of verifications in order to test the accuracy of our general conclusion that tip seed yielded larger crop than central seed. The reply to our questioning must not be interpreted in bushels, for the exact yield and differences may be dependent upon circumstances of a local nature, but in terms of greater or less. So also we may seek to verify other questions of practical concern, and of a like nature.

Dissemination of the results of our work is another important object of the station work. Good work may be done by us, and yet but little benefit accrue unless brought to the attention of those who will

profit by the knowledge. Unless a success be made in our efforts to familiarize the farmers with the station work, we cannot hope for that full fruition to the hopes under which the station was established, nor can we expect to act as a stimulus to individual effort in the great and attractive field of research embraced in the term "intelligent agriculture." In order to bring ourselves before the farming public, weekly bulletins have been forwarded to the agricultural press of the State, and to such other papers as have applied, as also to many outside of the State.

To our visitors we are under obligation, for to all such, so far as circumstances have admitted, we have taken pains to not only exhibit, but explain the work in progress, so that each in turn might serve as a means for disseminating ideas as furnished by the station work seen and understood. We are glad to note an increase in number, as shown by the visitors' register, over last year. The number of visitors each month is shown in the following table:

	1882.	1883.
January		33
February		28
March		19
April	34	22
May	33	38
June	52	142
July	92	116
August	268	364
September	48	119
October	49	47
November	36	18
December	14	19
Total	626	965

Your director is under obligation for services offered and rendered by many gentlemen who are justly considered authorities in their special lines of research, as also to the many friends who have contributed articles for station use. The following list of donors illustrates the interest that friends of agriculture have in our work. The value of such helps is not to be measured by the quantity, but by the quality, and we express especial thanks to those who have contributed seed of new, novel or rare plants:

List of Donors.

Jan. 11. From Prof. Spencer F. Baird, Smithsonian Institution, one copy each of the Smithsonian miscellaneous collections, Nos. 276, 288, 289, 358 and 441.

Jan. 12. From A. B. Cleveland, Cape Vincent, N. Y., one quart of first and best peas.

Jan. 13. From H. M. Sessions, sample of rice wheat (a sorghum) seed.

Jan. 19. From Luther Tucker & Sons, editors *Country Gentleman*, Albany, N. Y., samples of wheat, oats and potatoes.

Jan. 20. From the Regents of the University, through David Murray, secretary, 19th to 31st annual reports of the New York State Museum of Natural History, 1866 to 1878, 13 vols.; 89th to 94th Regents' reports, 1876 to 1881, 6 vols.; New York State Library catalogues, general library, 1855, and law library, 1855; general library, first supplement, 1861; law library, first supplement, 1865; subject-index general library, 1875; 56th to 64th reports, 1873 to 1882, 9 vols.

Jan. 29. From H. Prestoe, director, Trinidad, report of the botanic gardens, for 1880.

Feb. 3. From Prof. I. P. Roberts, Ithaca, N. Y., twenty bottles of wheat in varieties, and specimens of corn on ear.

Feb. 3. From Department of Agriculture, Washington, D. C., one copy of annual report, 1881-2.

Feb. 4. From B. K. Bliss & Sons, seedsmen, New York, twenty-one varieties of seed.

Feb. 5. From James Vick, seedsman, Rochester, N. Y., vol. 5, Vick's Illustrated Monthly Magazine, 1882, as also full number for current year as issued.

Feb. 8. From A. B. Cleveland, Cape Vincent, N. Y., a package of Carter's telephone pea.

Feb. 10. From R. Schomburgk, director, Report of the Botanic Gardens of Adelaide, South Australia, for 1881; a catalogue of the plants under cultivation in the government botanic garden, Adelaide, South Australia.

Feb. 10. From the New York State Amber Cane Association, samples of Amber cane sugar and syrup.

Feb. 14. From Hiram Sibley & Co., seedsmen, Rochester, N. Y., packets of beans, cow-peas, grass seed, flower seed, various vegetables, barley, wheat, oats, etc., together with novelties from Japan.

Feb. 16. From Hon. Josiah Shull, Ilion, N. Y., copies of Sixth Annual Report of the State Dairymen's Association for 1882.

Feb. 16. From Maj. Henry E. Alvord, Mountainville, N. Y., persimmon seed.

Feb. 19. From H. G. Wolcott, Fremont, Nebraska, improved ice cream watermelon seed.

Feb. 19. From Prof. W. R. Lazenby, director Ohio Agricultural Experiment Station, Columbus, samples of corn for seed and for museum.

Feb. 24. From Department of Interior, Compendium of the Tenth Census of the United States, 1880.

Feb. 26. From Prof. S. W. Johnson, director, the Annual Report of the Connecticut Agricultural Experiment Station for 1882.

March 2. From Hiram Sibley & Co., seedsmen, Rochester, packages of beans, peas, cabbage, oats and barley.

March 5. From Horatio N. Beach, U. S. Consul, Puerto Cabello, Venezuela, nine samples of Venezuelan beans, two of corn, one of squash and one of muskmelon seed.

March 5. From the North Star Seed Farms, St. Paul, Minn,. samples of Red River Sweet and Mandan corn.

March 5. From the New York Tribune Association, one copy of New York Daily Tribune and one copy of New York Weekly Tribune, during the year.

March 5. From E. S. Carman of the Rural New Yorker, New York city, seven packets of various seeds.

March 8. From Frank M. Etting, Concordville, Pa., one packet of Red Mediterranean wheat.

March 9. From E. S. Carman of the Rural New Yorker, New York city, samples of black bearded wheat.

March 9. From W. A. Armstrong, Elmira, N. Y., a package of Mexican tree beans.

March 10. From Prof. W. R. Lazenby, Ohio Agricultural Experiment Station, Columbus, O., ears of corn purposely hybridized.

March 16. From Prof. Peter Collier, Washington, D. C., thirty-six varieties of sorghum seed from China, India and Africa.

March 24. From D. Morris, director, Annual Report of the Public Gardens and Plantations of Jamaica, for 1882.

March 30. From Hiram Sibley & Co., seedsmen, Rochester, seed potatoes.

April 4. From Lyman Wall, Webster, N. Y., samples of Wall's Orange potato.

April 5. From F. H. Horsford, Charlotte, Vt., samples of hybrid wheat.

April 5. From Hon. T. S. Gold, West Cornwall, Ct., seed corn in several varieties.

April 6. From William Saunders, Washington, D. C., two ears of corn supposed to have been grown from seed taken from Indian mound on San Francisco river, Arkansas.

April 9. From S. M. Wells, Wethersfield, Ct., several varieties of onion seed.

April 11. From J. G. Lemmon, Oakland, Cal., tubers of the wild potato from Arizona.

April 12. From Prof. H. E. Alvord, Mountainville, N. Y., one copy Houghton Farm Experiment Department; Agricultural Physics, 1882.

April 14. From D. S. Marvin, Watertown, N. Y., one Centennial grape vine.

April 21. From W. R. Guilfoyle, Melbourne, Australia, one copy each of Annual Report of the Melbourne Botanic Gardens, 1875, 1877, 1882.

April 23. From T. D. Plumb, Madison, Wis., sample of clover seed.

April 23. From G. H. & J. H. Hale, So. Glastonbury, Ct., one plant of Mrs. Garfield strawberry.

April 25. From D. M. Ferry & Co., seedsmen, Detroit, Mich., packages of pea and been seed.

April 30. From M. F. Pierson, Seneca Castle, N. Y., five varieties of potatoes.

April 30. From B. K. Bliss & Sons, seedsmen, New York city, one packet each of eight varieties of potato and two varieties of peas.

May 3. From J. C. Vaughan, seedsman, Chicago, Ill., some ears of Red River corn.

May 5. From H. Sazé, Tokio, Japan, three varieties of the Soja bean.

May 9. From Benjamin Whitlock, Lyons, N. Y., samples of potato and millet.

May 10. From C. H. Spalding, Hess Road Station, N. Y., a packet of Niagara cane seed.

May 19. From Messrs. Burrell & Whitman, Little Falls, N. Y., six pecks of fodder corn seed.

May 24. From T. H. Foster, Lansing, Mich., one copy of Michigan Horticultural Report, 1882.

May 29. From Prof. C. W. Dabney, Jr., one copy of North Carolina Agricultural Experiment Station Report, 1882.

June 7. From Hon. John E. Russell, secretary, Boston, Mass., one copy of Agriculture of Massachusetts, 1882.

July 26. From Prof. W. H. Brewer, New Haven, Conn., one copy of Investigations of the Scientific and Economic Relations of the Sorghum Sugar Industry, Nov., 1882.

July 30. From Hon. Geo. B. Loring, Commissioner of Agriculture, The Sorghum Sugar Industry, Report of the National Academy of Sciences, Nov., 1882.

Aug. 31. From Prof. S. F. Baird, Washington, D. C., one volume Smithsonian Report, 1881.

Aug. 31. From O. H. Alexander, Charlotte, Vt., two seedling potatoes, packets of oats, wheat and corn.

Sept. 1. From L. L. Crocker, Farmers' Fertilizer Co., Buffalo, N. Y., one ton of superphosphate.

Sept. 25. From R. Schomburgk, director, Report of the Botanic Gardens at Adelaide, South Australia, for 1882.

Oct. 5. From Hon J. W. Wadsworth, M. C., Geneseo, Statistics of the Population of the Tenth Census.

Oct. 8. From William Trelease, secretary, Madison, Vol. XII Transactions of the Wisconsin State Horticultural Society.

Nov. 7. From W. S. Allen, Chocaluskee, Florida, various packets of seeds.

Nov. 19. From J. G. Lemmon, Oakland, Cal., seeds of Tagetes Lemmoni.

Nov. 23. From Prof. J. A. Lintner, Albany, N. Y., one copy of First Annual Report of the Injurious and Other Insects of the State of New York.

Nov. 28. From F. H Horsford, Charlotte, Vt., one packet of bald barley seed.

Dec. 11. From Prof. Chas. H. Peck, Albany, N. Y., the 33d *to* 34th Annual Report of the State Museum of Natural History.

Dec. 17. From American Dairy Salt Company, Syracuse, N. Y., one barrel of factory filled salt.

Dec. 22. From Prof. C. W. Dabney, Jr., Raleigh, N. C., eighteen packets of seed from Teneriff.

The station officers have given to their work that close accurate attention and personal interest which justifies the warmest mention. To their labors the director is indebted for much of whatever suc-

cess may be meted out to the year's labor. During the twelve months there has existed harmony between, and faithfulness on the part of all. At times the calls upon them have been frequent and wearing, their duties at times distasteful, yet in every respect personal consideration has cheerfully given way to duty. To Mr. Wing, the assistant; Mr. Goff, the horticulturist; Mr. Lovett, assistant horticulturist; Dr. Babcock, the chemist, and Mr. Watson, the stenographer, are due this reference, for each, as occasion arrived, has given friendly assistance to the work of the other, spontaneously, liberally and effectively.

E. LEWIS STURTEVANT, *Director.*

DIRECTOR'S REPORT.

One of the most important, nay the very fundamental condition of experimental work, is that we shall correctly interpret the results of our work. If guesses are to take the place of method, then we might as well guess at our work in advance instead of going through the formality of measurings and weighings. The plat system of experimenting, from its apparent simplicity, has entered into general practice amongst experimenters, and the results of figures gained are, in general, received without question. The figures gained under this system of equal plats are, however, more apt to afford incorrect than correct conclusions, as usually interpreted, and it is well worthy of discussion whether there may not be some method which will enable us to detect inaccuracies and decide as to the values of our figures in their relations to greater or less.

In the station work an attempt in this direction is being made — to a certain extent provisional in its nature, as subject to improvement as experience is gained. Through harvesting our plats in separate portions in such a way that adjoining sections admit of comparison of yield, it seems probable that some idea of the uniformity or lack of uniformity of soil conditions can be obtained, and the information thus derived be made available. Exactness of figures cannot be expected to prevail between duplicate plats, as absolute identity of conditions cannot be forecast; in every such trial there must exist some differences between the yield of independent areas, as arising from the complex agencies which affect plant growth, in itself dependent upon a complexity of hereditary environment. If, then, we cannot expect to obtain identity between two plats under duplicated conditions, the query comes as to how closely the results must figure in order to serve the purpose of an experiment. When our query takes this form, we at once seem to recognize that for each class of events there are certain limits within which normal variations may take place, limits which are to be defined by a careful investigation, as deduced by experiment, of the variations which actually may happen in a given number of plants upon a given area, under conditions of a presumed equivalency.

The errors which most frequently occur in plat experimentation may be grouped as follows: first, those dependent upon the lack of uniformity of character in the seed used; secondly, those which arise from the number of plants which survive and attain maturity being different in each area; thirdly, from the area of soil not being the same for each plant that produces the crop. As a corollary to this statement we may then say that the first endeavor in plat experimentation must be to secure uniform seed, and to establish for each plat the like number of maturing plants occupying similar spaces for root

feeding and growth development. At harvest, it must be observed how nearly these conditions have been satisfied, and when discrepancies occur, these discrepancies must have their effect estimated according to some rule derived from experience, and the resulting figures from the investigation either added to or subtracted from the actual yield, according to the need. The next process toward our obtaining complete results must be the satisfying ourselves of the equivalency of the seed used, and of the evenness of the fertility and of the physical conditions of the soil, through the study of each plat divided into smaller sections, and as well of the conditions of the surrounding soil, through the careful use of duplicate series of plats, bearing in mind that the figures gained cannot be expected to be identical between duplicates, but only to be valued as they fall within well-established limits of error.

That the station has not in all cases followed these laws of interpretation is a misfortune that arises from the newness of its attempts, and from the want of sufficient data, and a well-verified series of observations which can be regarded as constants for given circumstances.

It is a good rule, however, for the farm experimenter to consider, that when the variation between two plats differently treated is no greater than between plats treated alike, then the figures which are intended to be for or against any practice are unsatisfactory, and cannot be accepted as infallible guides as measuring the influence of the changed condition. It is also well to be remembered that if it is justifiable to interpret gain or loss according to our prepossessions in any one case, then it is logical to interpret figures of like meaning and like import even when counter to our beliefs. If, for illustration, we plant two plats with corn, and to one plat apply fertilizer, and harvest from the fertilized plat ten bushels more of corn, then, if we accept this ten bushels as the measure of the efficacy of the fertilizer, we should estimate weeds also as of ten bushels advantage, when, upon two plats, one weeded and the other growing abundance of weeds, we harvest ten bushels more of crop from the weedy portion.

We would, by no means, undervalue our appreciation of the importance of the expectation that this station will be of benefit to practical agriculture, yet a close acquaintance with the difficulties that beset our path leads us to the candid admission, that the most important portion of our work is the learning how to experiment, and how to interpret our results. We must expect to find much of our labor thrown away upon efforts which shall not yield an adequate return, and we must expect our path to be marked with failures, saddening at the time, but from which lessons may be derived for future progress. Indeed, in well-directed experimental trials, failures may be even considered at times of advantage, as teaching lessons which might not otherwise be learned.

The leading aim of an experimental station such as ours must be by experimental study of the most careful kind to obtain knowledge of the action of the laws which find application in agriculture, and to devise methods for the application of the knowledge gained, in order that in practical farming waste of means and effort may be diminished, and gain may be increased, and thus profits be forwarded.

The one discovery in cattle feeding this year opens up a field for re-

newed experiment which seems hopeful for gain. That the churning quality of milk and its chemical quality bears no exact relation is a discovery of consequence, as well as the fact disclosed, that the character of the food supplied to milch cows affects the churning quality of the milk more than it does the chemical quality. It seems now to be plainly evident, that for practical dairying, the churn is the only reliable implement which we have in determining the butter quality of the milk; analysis the only reliable method other than experimental of determining the food quality of milk. It is, however, not without interest that specific gravity and cream percentage offer guides, when correctly interpreted, as to the quality of milk, and it is only when we assume from such observations more than the data which they offer warrants that we should expect error of judgment and mistake as to fact. It is a safe rule to observe, that when difference of opinion arises as to results gained, it is usually due to imperfect reasoning and difference in knowledge, or to the applying of the facts observed upon material of different origins, but assumed by opponents to be of like character.

A difference of opinion between two persons, as the late Professor Agassiz once remarked to me in conversation, usually arises from difference of knowledge, which leads each to view the matter from a different standpoint. Equivalency of knowledge gives agreement. Indeed, it is with me a matter of universal observation that the facts offered by farmers are not usually to be questioned; although very often the interpretations of the facts observed are in error. To rightfully connect cause and effect requires careful education and training of the faculties, and to interpret justly facts in their proper relations requires most considerate study.

The greatest stimulus to research that we have is in the occurrence of variations. The beautiful example of experimentation in Darwin's book on Cross and Self-Fertilization in the Vegetable Kingdom originated from an observation that in two beds of toad-flax, the one sown with self-fertilized seed, the other with cross-fertilized seed, there was a difference of height between the plants of the two beds; this fact verified another year by a like observation upon the carnation pink, suggested the investigation into its meaning, and brought to our notice the general law that in plants cross-fertilization is beneficial, self-fertilization injurious; a law which has an important and practical bearing upon the production of agricultural seeds for sale and growth. In the records of our butter factories we have, as comes to me from good authority, a sometimes daily variation in the value of milk for manufacture, a variation greater in amount than can be ascribed to errors in the churning. In our private dairies the same fact may be observed, as Professor Alvord has so well shown at the Houghton Farm Experimental Station at Mountainville, this State, as well as that variation occurs with individual cows, and with change of feed. These variations have a meaning, and their study should make us acquainted with their cause. The cause once apprehended and studied, it is nearly certain that the factors of variation will be found amenable to human effort, and that we may expect by influencing to diminish the differences now observed, and thus acquire the power of increasing product by diminishing waste. Professor Alvord, than whom we have no

better dairy critic, in an article in the *Country Gentleman* of November 1, 1883, says: "The valuable dairy experiments conducted at the New York Agricultural Experiment Station during January and February, 1883, indicate the importance of a careful study of the effects of food upon the churning quality of milk; they show a much greater variation between the actual fat in the milk and the butter obtained, as the results of differences in food, than has been heretofore recognized," and in giving the results of the Houghton Farm studies, he not only verifies our conclusions, but adds very much information of great value to the dairyman, gained from a herd under experimental as well as normal conditions. Indeed, Professor Alvord has proven not only a capable observer, but an excellent generalizer, and has added available knowledge through his this year's experiments for the consideration of dairymen, and fortunately the work of the private station has been in a line with that conducted by the public station.

The subject of the germination of seeds is an important one, not only in its relation to the farmer, but as well to the seedsman. The seedsman occupies a position of great importance to the progressive farmer and is deserving of appreciation rather than abuse. Without this gathering together of varieties from nearly every source of supply, this constant search after new things and improved varieties, this constant effort after reliability, and this constant maintenance of large stock, our agriculture would perforce become hampered, from the inability of the grower to secure the benefits of advance made by others. The select body of men, whose business is the improvement of seed and the originating of new varieties, would become discouraged through the expense in distributing their produce at a price which would justify the making of their specialty into a business. Seed would lose purity through the being grown in small patches, and the only means of maintaining many kinds in a pure state, that of growing seed of like kinds in large fields whereby risks from hybridization are diminished, would be unavailable. For instance, we may evidence the cabbage, a crop perhaps as dependent upon the purity of the seed for its successful growing as any plant in general use. The flowers of this plant are adapted for cross-fertilization as well as for self-fertilization. It is a well-known fact that varieties are crossed so largely by insects that it becomes impossible to raise pure seed in the same garden where more than one kind are in flower at the same time. It is also abundantly proven that the produce from seed which are self-fertilized is very inferior to the produce from seed fertilized with pollen from another plant of the same variety. It is evident that where large fields of cabbage are grown for seed, insects will be continually at work conveying pollen from plant to plant, and thus furnish absolute provision in the vast majority of cases against self-fertilization, and from the preponderance of the one variety we have a great safeguard against the introduction of pollen from other varieties. This presentation of abundantly verified facts clearly shows that the seed-grower upon a very small scale cannot produce seeds as valuable to the consumer as can the seed-grower upon a large scale, and it is only through the business of the seedsmen that the large grower, the grower of the best seed, can be encouraged.

The seedsman obtains his seed from many sources of supply, and it

becomes impossible for him in all cases to verify the quality of the seeds that are furnished him. His business requires the keeping accounts with so many kinds and so many different sources that individual control cannot be exercised, but much must be trusted to subordinates. It is not surprising, then, that mistakes sometimes occur, and that occasional dissatisfaction is expressed by the purchaser. The extensive use of seedsmen's seeds by the station has, upon a general view, furnished very satisfactory results, a continual source of surprise when the difficulties which surround the seedsman's business are considered. Our experience, however, leads us to criticisms upon seedsmen, and upon the character of the seeds supplied, which we must assume are justified more by lack of knowledge than intent on the part of seedsmen, and unfortunately, this lack of knowledge we cannot at present supply.

Thus, we must know absolutely what species of vegetables cross fertilize, the value of the probability and the length of time required to eliminate from a variety the effect of previous cross-fertilizing. This being known, seedsmen should insist that those who grow their seed supply should grow but one variety of a species, liable to cross fertilize and this from seed furnished by the seedsmen, and of known purity. Seedsmen attempt this, but that they do not always succeed is shown by the fact that no radish seed used at the station has as yet yielded plants uniformly of the variety sown, but usually showing great diversity.

We must know the influence of the soil upon the habits of the seed grown thereon, as for illustration, the pea, for which it is stated on good authority that dwarf varieties grown on mucky land furnish seed which tend to produce a taller-growing, more prolific kind upon other soils. This fact is utilized by one seedsman of our acquaintance who supplies the market gardeners of the south with pea seed grown purposely on mucky soil in the north, whereby it is claimed, and apparently justly, that this seed furnishes plants that ripen their seed mostly for one picking, thus allowing the ground to be quickly cleared for the reception of another crop. The question of climatic influence also is to be considered, for both soil and climate seem influential in changing the habit and quality, not so much the type, but perhaps this also, of the seedling. Until this matter of soil and climate influence become proven, or determined, we must expect no change in the seedsman's methods in this respect, but yet some of the seedsmen already have commenced, and properly, it seems to us, to advertise seed of the growth of particular sections.

Pedigree in seeds has a value; this can be affirmed positively, although the fact has not the general recognition that will admit of our criticising too harshly a divergence from this belief. Through the non-recognition of this fact arises an unwillingness on the part of seedsmen to pay for this quality, and hence seed distributed as of like variety, and which, indeed, produce likeness in type, yet vary much in habit of plant and prolificacy.

Prolificacy in some vegetables depends upon other conditions than the seed used, or the soil upon which planted. When plants depend upon insects for the fertilization which is to cause seed, then these plants are fruitful according to the presence, the activity, and even the

habits of such insects. Thus, for a perfect illustration, the Scarlet Runner bean is partially sterile if the visits of bees be prevented. In Nicaragua, where the flowers are not visited by insects, the species is quite sterile. Oftentimes bees, however, acquire the habit of cutting holes in the flower in order to get at the honey, and when they do this they do not come into contact with either the pollen or the pistil, and hence their visits are useless to the plant. These facts, as noticed by Darwin, give clear expression to the indebtedness we are under to agencies at first thought far remote from practical affairs, and illustrate in a manner the diversities of agencies to be considered in calculating the results of an experiment.

We have no criticisms to offer concerning the distribution of dead seed, or seed of such an age as to be unreliable. No such cases have come under our observation. Occasionally varieties have failed to germinate or to vegetate, but these few cases may rather be considered accidental than as having a general meaning. It is time now that we should cease the quoting of adulteration and fraud proven to be carried on in Germany and England as applicable to this country, and from reasoning from these foreign facts conclusions derogatory to our seedsmen. In our country competition amongst seedsmen admits of no gain from fraudulent practices, and *prima facie* honesty should be looked for in preference to fraud. It is a good maxim in thought, as in law, to consider a man innocent until there is reason to believe him guilty.

From our experience with duplicate trials in germination, we must deplore the system which shall condemn one seedsman and inferentially indorse another, through variation in the germinating properties of seed from single packages sold. That this method may be a just one when practiced on a sufficiently large scale seems probable, but not when undertaken with few samples, and without the check upon our conclusions which are to be derived from duplicates. *Prima facie*, so far as our own observations teach, seedsmen's seeds, irrespective of whom purchased, are certainly not inferior in germinating properties to those raised from single plants at the station.

We have made no trials with "commission seed" this year, as our trials last year seemed sufficient to condemn a system which is capable of so much abuse, and which, in the light of our mail and express facilities, seems unnecessary. It would seem to us as if self-protection would lead seedsmen to abolish this method of sale which places them at the discretion of so many agents, many of whom may be careless. We would not condemn the custom of distributing goods for sale, but only the method which removes from the seed the real guarantee of the responsible parties, and which, while the packets are indorsed by the seedsmen, yet are really dependent upon the care and good faith of series of agents far removed from the distributing center. It is probably to this system in vogue that we are indebted to the reluctance of many to patronize seedsmen directly and try improved kinds of seed, for those who have been deceived by "grocery packets" of seed can scarcely be expected to feel encouraged to extend their future attempts to secure change of varieties, or of seed.

One of the objectionable features that we would call attention to is the multiplication of synonyms in our seed catalogues; a multiplica-

tion which must be entirely unnecessary in the majority of cases. Thus, in the catalogues of eight extensive seedsmen one variety of cucumber appears under the following names: Long Green, Improved Long Green, Improved Long Green Prickly, Extra Long Green Smooth, Long Green Smooth From Athens, Long Green Prickly, Long Green Turkey, London Long Green. Again, we find Early White Spine, Improved White Spine, Peerless White Spine, Improved Early White Spine, Improved Early White Spine or Arlington, Extra Long White Spine, Early White Spined, Extra Long White Spined, Improved White Spined, White Improved Spine.

It is no exaggeration to say that such a use of names tends to reduce vegetable nomenclature to a farce. We find no such abuse in the catalogues of our nurserymen. If the Northern Spy apple is offered, it is not called Extra Large Northern Spy, Improved Scarlet Northern Spy, or Extra Large Red Northern Spy.

It may be urged that the altered name as applied to a cucumber is intended to designate a new and improved variety. If so, we simply say that it would seem to be the policy of the introducer of an improved variety to give it a name that cannot be confounded with the names of older and inferior varieties.

We may suggest that in the description of varieties offered in our seed catalogues, that whatever be said, be scientifically accurate, as this would have far more influence upon the public than series of epithets so glowing that they cease to discriminate the differences which occur, and thus tend to bewilder rather than to enlighten the reader who is seeking for knowledge.

To attain results in experiments in pomology necessarily requires much time. The station has initiated an attempt to ascertain whether we can utilize observations concerning the character of wild and improved fruits in the direction of governing the production of varieties. We have seedling strawberries, raspberries and currants growing from seed taken from many-seeded individuals and few-seeded individuals, some of which may be expected to fruit another year. Other attempts at experiment will be found in the report of the horticulturist.

In the study of varieties in the garden we have made some progress toward description and classification, as appears in the following presentation. We have also experimented with varieties as shown in the horticulturist's report.

To have the applications of science, says Professor H. A. Rowland, the science itself must exist. This remark is peculiarly applicable to agriculture. Too often in the search after practical experiment we do not recognize as a fact that we already know too little of the reasons which underlie the various processes which occur, to succeed in our interpretations of cause and effect. Before much real practical advance can be made in bringing agricultural pursuits within the domain of applied science, much work of a purely scientific character must be accomplished, and unpopular as it may be for the worker, yet that worker who investigates agricultural problems, not from the economic, but from the reason stand point, is doing the best work, and the work which in the end will be found most profitable in its applications.

It is wise in all our work to recognize all our short comings, and to recall to our minds with frequency what limitations to advancement

exist to check progress, in order that by well directed study these limitations may be carried to a further remove. It is by recognizing, not ignoring difficulties, that agricultural investigation is to be furthered.

It is, however, the duty of an institution, founded and maintained by a public appropriation for a practical purpose, to endeavor by all means at command to fulfill the expectation of its supporters, and hence we give our greater attention to the practical element of agriculture, and we have ever in mind economic applications. If our knowledge, or published knowledge, is deficient, we attempt by the recognition of the deficiency to pursue investigations which shall give us more command over applications in the future, and we hope as time passes we shall ever be better fitted for deducing from experiment such knowledge as shall avail to diminish waste and secure increase in the practical arts included under the term husbandry.

One of the difficulties, and a great one, which meets the investigator, is the variation induced by the variety habits of plants or animals. A conclusion obtained, true for the variety or breed under observation, may not necessarily be true for another variety or breed, and hence it becomes of importance that we shall define with great care the variety or the breed from whose study such conclusions as we offer are derived. This fact necessitates much descriptive work on the part of some, and attempts at classification.

Agriculture is artificial, as distinct from natural. It deals with plants and animals and soils removed from the conditions under which they naturally occur, and developed by human skill and control away from the purposes of nature in the direction most suited to man's necessities or desires. The breeds of animals which represent the highest skill of man would certainly deteriorate and lose in large part those characteristics which give them their value, if abandoned to themselves, and to the conditions which we call natural. So also with plants. Our cultivated species of improved character can only be formed or maintained in their perfection under the conditions of art. We thus must recognize that human effort which causes changes in animals or plants, and which secures adaptation to a real or fancied want, is a factor which dominates the natural factors in directing development, and in securing specified artificial conditions.

This factor deserves the most careful study as being at the foundation of agricultural improvement, for it is only by a clear appreciation of its power for producing change, of the nature of the changes, of its reactions with heredity, and even of its limitations that we can properly study this pursuit which has been well defined as the oldest of the arts.

If we examine our vegetable productions, we can note various facts of interest and of importance. It seems certain that our cereal plants, wheat, rye, barley, oats and maize are unknown, in their present form at least, in a state of nature, and are the results of developments through man's art, from some unknown, and perhaps little resembling natural form. It is equally certain that all these plants have become varied under the artificial circumstances of continuous selection, into very many distinct varieties of differing properties as regards shape of seed, habit of growth, prolificacy, hardiness, etc. The potato has

become developed into a large yielding, large tubered, compactly fruiting (if the tubers be termed the fruit) plant, from a small yielding, small tubered and diffusely fruiting original, and in correspondence with the improvement, the power of bearing fertile flowers has mainly disappeared. There have also been secured variations in hardiness, earliness, size of tuber and of plant, and edible quality of tuber. The beet, from a worthless sea-side plant, has been changed into three types, the beet proper, the chard beet, and the mangold, each of which has varied into many distinct forms, and the types coming true from seed. The turnip, from a disputed or hybrid original, has acquired a series of variations which has adapted it for most varied wants, as a garden plant and as a field crop, the varieties varying most noticeably in shape of root, size, earliness, color, foliage and hardiness. The cabbage, from a worthless original, has furnished types which may almost be called species, the resemblance being so little marked, and the variations being so strongly marked in the various kales, kohl-rabis, marrow-cabbages, cabbages, Brussels sprouts and cauliflowers. Among the garden plants the common kidney bean, unknown in a wild state, has furnished hundreds of varieties, each well marked. The wild carrot with small woody root, has been changed into a plant bearing succulent large roots of very diverse forms; the celery from a suspicious, oftentimes poisonous plant, now furnishes our most esteemed salad, and in one series of varieties the root has become changed to a bulb; the cucumber, egg-plant, endive, and lettuce, have also given us numerous varieties widely varying from the wild state. The onion, from a scarcely recognized original, produces not only bulbs of varying size and form, but also changed habits of bearing, as in the potato onion, the top onion, etc. Peas have changed from the wild plant into numerous varieties, differing not only in the appearance of the seed, and the shape and quality of pod, but as well in earliness and habits of growth; peppers vary so strikingly that it is only by the historical record that many varieties can be assigned to the same species. Noteworthy variation can also be mentioned for the whole squash or pumpkin class of plants, for the tomato and others.

All these variations, as striking as they are to the imagination, are the outcome of the force exercised by man and directed antagonistic to the design of nature; for in nature the dominant intent is the preservation of existence of the species; under art the dominant intent is to become subservient to man's wants, trusting to him for that protection which in nature the plant must acquire for itself.

It follows from these facts that development in the natural plant is in accordance with the necessity of self-preservation, the plant acquiring that character which best fits it for competing with itself and its adversaries, and as the seed is the predominant and well nigh universal means whereby in nature dispersion and reproduction is secured, the floral organs acquire a prominence and a fixity in proportion to the uniformity of the object to be attained, and hence furnish the data for a natural system of classification as expressing the motive of the species' existence.

It equally follows, that under art, the necessity for self-preservation is removed and the necessity for the development of the floral organs becomes subordinate, as man's care provides for the preservation and perpetuation of the species. Under art a new force is exercised upon

the plant — artificial selection it is called — which dominates over the natural forces and furnishes the direction for growth. Hence in the cultivated vegetable variation occurs in the part and the habit upon which selection is exercised and wide divergence of plant form occurs, with little variation in general in the floral organs which are not purposely influenced.

As the forces of nature have been more constant and longer exercised than the forces of art, it follows legitimately, what observation teaches as well, that there is a greater constancy and a stronger resistance to disturbing forces in specific forms in nature than in the forms produced by art.

From this slight statement, which furnishes the ground work of our reasoning, it seems to me to be clearly deduced that as in nature the dominant motive or intent of plant growth which provides their form, furnishes fit material for a natural classification, so in cultivated vegetables the dominant motive for their existence, which provides their form, furnishes also a sufficient material for an artificial classification in strict accordance with nature's usages.

The importance of this idea justifies a repetition. Nature's methods tend to adapt the plant for self-maintenance, and all the plant attributes are moulded to this end. Man's methods tend to adapt the plant produce for man's use or caprice, irrespective of the ability for self-maintenance. Thus, in wild fruits we have seeding as a normal characteristic; in many of our best cultivated fruits seeding has ceased to be a normal characteristic, as in the banana, the pineapple, and in varieties of the grape, mulberry, orange, etc. The object in general for the plant under nature to attain, is the production of seed in such a manner as to secure the preservation of its species; the object of the plant under cultivation is to develop those portions which are to become beneficial to man, as compelled by the forces brought into agency by the acts of man. In plants in nature the parts are developed for the service of the plant as guards against the constant conditions that its situation implies; in cultivation, man guards the life of the plant from these necessitous conditions of the wild state and allows the plant thus relieved to respond to applied conditions designed for the furtherance of the development of those parts in which man's wants are interested.

Under the guidance of nature, form is moulded to the necessities of the plant; under the guidance of natural forces by man, form becomes moulded to the necessities of man. If these statements are in accordance with fact, we must recognize that the classification which is natural for nature's wildings, becomes unfitted for like service for plants whose development is dominated by man. In botanical classification and description we have a means whereby species and natural varieties can be identified, and thus the study of plants can be forwarded. In agriculture, we at present have no proper classification of agricultural varieties whereby varieties can be brought together in accordance with artificial types so as to be readily identified. Hence, in botany, we find clearness and precision; in agricultural botany, confusion and uncertainty.

The differences between agricultural varieties of a species are often greater than between natural species within a natural genus; differences not only in form and appearance and qualities, but as well in habits of growth and prolificacy, and in reactions to the means at the

disposal of the cultivator. Hence we cannot expect to attain the same precision for agricultural botany as is already attained for natural botany until there is recognized that the two studies are not governed by the same dominant controlling motives nor by the same rules for classification; until it is recognized that as for the purpose of the botanist the genetical relationship of plants is the key to the proper classification and identification of plants, so for the purposes of agricultural botany the relationship of form and use, as produced by forces directed by man, is to furnish the key to the agricultural classification.

We may be pardoned for calling attention to the importance to agricultural experiment of a scheme which shall enable us to classify varieties for the purpose of identification. At present, in default of historical evidence of the equivalency of varieties, the work of distant experimenters cannot well be in unison, nor can changes produced through cultivation or through climatic conditions or through series of selections be recognized and recorded in proper relation. So long as it is certain that the variety differences which occur in our cultivated plants have a distinct value to the grower, it becomes essential to accurate experimentation and to the drawing up of conclusions for practical directions that some method for the recognition of similar varieties through description alone shall be devised. There is no more important work for a station to carry on along with its more immediate practical duties than one which shall enable this condition of systematic identification of varieties to be fulfilled.

In the study of some eleven hundred or more different varieties of agricultural plants as grown at the station in 1883, some general conclusions appertaining to a systematic description were obtained.

Variations through the use of seed apparently cross-fertilized, or in other words, of impure variety seed, were very noticeable.

Variation between seed planted through the use of mixed varieties of seed purchased.

Variation from seeds presumably of one variety and presumably of not recent cross-fertilization.

When the effect of cross-fertilization and of mixed seed was carefully estimated, the constancy of the plant to type, especially in that portion of the plant which finds use, was very marked. We are prepared to admit, generally speaking, that we found a great uniformity between individual plants of a variety in those portions for which the plant was grown, and a more or less variation in those parts of the plant considered unessential to use. Thus, in beets, the tops varied more than did the roots; in cucumbers, the fruit varied more than did the foliage.

In the older varieties of plants the constancy of the individuals to type was extremely well marked, even in some cases leading us to believe that the seed had resisted hybridization from adjoining varieties; in the newer varieties, the so-called novelties, constancy to type was less well maintained.

In general we are led to suppose that those artificial varieties, whose form has received recognition as desirable, display a uniformity to type which admits of classification and description, and a type which resists change so long as the plant is exposed to the conditions of cultivation. We are also disposed to believe that in case of such strongly marked

varieties as these we refer to, that the parent form is enabled to absorb some other types without prejudice to its own form. Thus, while most beans show the influence of cross-fertilization, the Refugee kept the color and form of its seed intact, although planted for two years adjoining other varieties. The Waushakum corn grown adjoining other varieties last year and this, and blooming at the same time, bore ears and kernels this year apparently on type, the exceptions being not one thousandth of a per cent.

We have indications of the fixity of an agricultural race under cultivation by the fact that the same type of maize as found in the Peruvian tombs exists at the present day; that the Flat Dutch turnip is apparently the same now as when described many years ago; that pumpkins exist now in the forms described by the early botanists and by the early voyagers; that many of the types of lettuce now found seem to correspond to those in use by the Romans, etc.

We have also to notice that in practice even varieties which hybridize the most readily are maintained true to type to such an extent as to admit of the seeds of varieties being sold by seedmen, and plants grown from these seeds in the main come true to the description which is offered.

Upon the whole, from two years' experience, we must affirm that agricultural varieties, in general, possess a fixity under the circumstances of cultivation, and only vary greatly when exposed to conditions other than those to which they have become fitted.

If our opinion of this fixity of varieties under the conditions for which they have been trained is correct, then classification and identification become possible, and it but remains to develop through trials a scheme which shall be scientific in its method, and reliable in its conclusions.

It certainly seems to me logical and proper to utilize the motive of the plant for the purpose of classification. In natural botany form is but subservient to structure fitted for the special purpose of self-maintenance of the species under a constant struggle against competitors and natural environment, and the floral organs become the representative of the dominant motive, and hence offer a basis for natural classification. In agricultural botany form and quality, designed for man's convenience, and not for the convenience of the plant, assumes prominence as the motive, and the floral organs become subservient so far as man is concerned, and in so far as they do not appeal to the human desire for change, and hence in agricultural botany classification must logically be established upon those fixed forms which have been produced and are maintained by the art and skill of man. In both natural and agricultural botany heredity is a factor which alike prevails, and, hence in the use of two different dominant motives for classification, we must not expect the two systems to coincide in the grouping and arranging, but oftentimes opposition. Thus giving prominence to the form of the part developed through man's agency would bring into one group those roots which hold a resemblance which is to be recognized as of a common type, as for instance, the Rose China Winter Radish and the Carenton Half Long Carrot, both of which have cylindrical roots premorse at the tip; under the natural system these varieties would be correctly classed as belonging to two different orders.

We may mention as a parenthesis in order to show the force of the motive impressed upon the plant by man that parallelism of certain forms is to be found between various orders, genera and species of plants, according as man's effort has been equally directed toward similarity of produce, as for illustration, between the forms of roots when the root-portion is the part desired; in the form of stems when the stem-portion is the part used; in the form of foliage when the foliage is the part in esteem; in the form of fruit when form has value to man, etc., etc.

It is very desirable to know somewhat of the order of changes which have occurred in agricultural plants, and to determine what forms are the least, and what forms have been the most modified by human agencies; to determine the successive stages of improvement in order to derive lessons which shall teach us how to go to work to initiate new changes which shall accomplish a desired result; and to recognize the resting places in form, which resting places can be adapted for purposes of grouping.

We will illustrate our meaning by bringing together a few of our conclusions regarding certain of our cultivated vegetables.

The roots principally grown in our gardens are the beet, carrot, parsnip, radish, salsify, scorzonera and turnip. Of these the parsnip, salsify and scorzonera are evidently but little improved from the wild state, the latter two scarcely at all.

If we critically examine the varieties of these roots we shall find a common variation from the wild form, where known, in the smoothing and enlarging of the root and the freeing from forking and branching. Salsify and scorzonera are examples of this stage. This improvement seems to have been generally attained, and to have but little special significance, except as indicating plants grown freed from competition and on rich soil. The common parsnip, for instance, when allowed to grow as a weed, becomes the wild parsnip of the botany, the roots becoming branched and diminished in size.

The first stage of improvement in vegetable roots seems to be in the enlarging of the base of the root in excess in diameter over the stem, and in obtaining a conical shape the fleshy portion tapering to the extremity, and in its improved sub-sections exhibiting a fusiform, spheroidal or almost cylindrical shape to the enlarged portions. This type finds representation in varieties of the beet, carrot, turnip, parsnip, radish and other less cultivated vegetables. This type may be called tap-rooting.

The second stage of improvement seems to be when there is a distinction gained between the swollen portion and the root, the root proper starting abruptly from the flattish surface of the fleshy swollen portion. Within this type we have spherical and ellipsoidal, more or less flattened, or even hollowed forms, occurring in varieties of the beet, carrot, radish and turnip. This type may be called the caudate or tailed.

A third stage of improvement is when the lower part of the fleshy root is abruptly ended, as if bitten off, and contains cylindrical and tankard shaped forms. Representatives are to be found in varieties of the carrot, turnip and radish. This type may be called the premorse, or bitten off.

Various anomalous and less improved types occur, which, with our

present knowledge we are unwilling to attempt to classify, as those wherein the roots form a capillary mass from the base of the bulb, as in varieties of celeriac and rutabagas; or those roots which are fascicled, as in the sweet potato and skirret.

If we apply to these divisions the methods of botany, we can group together the various results of similar selections in a form which admits of provisional classification as below:

Class, having reference to the portion used, or upon which selection has been exercised, as roots, bulbs, tubers, stems, leaves, foliage, fruits, etc.

Stages, corresponding in position to orders in botany, and including groups of selections within classes.

Sub-stage, a division of stages.

Forms, which correspond in position to botanical genera, and include groups within a stage of plants of similar outline of parts used.

Variety, which corresponds to botanical species, and form the unit of the system proposed.

We will illustrate by an example taken from roots. We will commence with an assumed order, as: —

Class 1. The roots the portion valued.

Stage 1. The taper root, the bulbous or fleshy portion tapering to the fine root at the extremity.

Sub-stage 1. The root elongated, very much longer than broad.

Form 1. Slender, cylindrical or nearly so, often branching, the collar portion not distinct from the root.

Varieties — to be described — gobo, horseradish, salsify, scolymus, scorzonera, etc.

Form 2. Shaped like a cone, but distinctly rounded at top.

+ *Growing nearly or quite under ground.*

Varieties to be described. — Crapaudine beet, White Silesian beet, etc.; Madgeburg chicory; Freneuse turnip, Morigny turnip, etc., Common Long parsnip; Tuberous rooted parsley; Long Scarlet radish; Wood's Early Frame radish, etc.; rampion.

++ *Growing wholly or in part above ground.*

Variety to be described. — Long Yellow carrot.

Form 3. Cone formed, flat or but slightly rounded, or hollowed at top, etc.

Form 4. Terete: cylindrical and but slightly tapering, etc.

Form 5. Cylindrical, but both ends ellipsoidal, etc.

Sub-stage 2. The root bulbous, the vertical axis much longer than the transverse.

Form 1. Spindle shaped, etc.

The other stages in class one might be stage two, the caudate or tailed; the root proper starting abruptly from the flattish surface of

the fleshy swollen portion. Stage three, the premorse; the lower part of the fleshy portion ending abruptly as if bitten off, etc.

This arrangement would admit, once granting the fixity of varieties, the at once assigning of a plant grown for its roots to a division containing so few varieties as to admit of finding quickly a close description of the variety to be identified by careful comparison of the description with the root in hand. At first sight this system, however, must appear awkward, on account of our non-familiarity, and present education in another direction; it certainly does not detract from its merits that universal knowledge will at once admit of calling a beet a beet, or a carrot a carrot, without referring to our table, which will, in practice, but serve to identify a variety within a species.

A careful examination into the motives which have been exercised upon other kinds of plants will furnish material suitable for carrying the system proposed into practice with all the agricultural plants, and will end, we may hope, in giving us an agricultural botany of precision, and which will require to be supplemented only by a genetic arrangement which shall give the position of the species in the natural system.

If seed of the various sorts of the cabbage family be planted alongside, a resemblance will be seen between all the seedlings at a certain date; it is only as growth proceeds that the development begins to differentiate differences. It seems probable, through a study of the laws of breeding, that the period of divergence marks the period at which original selection commenced in order to obtain our present forms. If this observation be substantiated, then by careful study of seedling development we shall be able to determine points of departure at which human guidance shall be enabled to direct in line with the tendencies of the plant. This study of plant-growth after the method used in zoölogy, the study of embryology so to speak, not the term "embryology" as applied to nature's plant, but that of man's plant, the period between the seed and the differentiation from the natural type, offers much promise of good result, and it seems quite probable that as we attempt to influence the development of the plant before or at the time of the differentiation into the acquired properties of the mature plant we can initiate a new series of selections in certain varieties whose root, bulb, stem and foliage finds use.

Thus, to illustrate, if a row of seedling beet plants be carefully observed, it will be noticed that at the first all the young plants have like roots; after a time certain roots will commence to vary in substance from their neighbors, and in a short time this variation will acquire the typical form of the variety in advance of the other plants. Through the marking of those plants which first change their form from the natural to the artificial plant, and reserving for seed purposes, and through doing this for several generations, we may hope to obtain an earliness in a new variety thus formed, which would only be accidentally gained through the selecting of the largest or best root at period of harvest. Our observations upon our seedlings will also show other points of divergence than earliness, as of the habit of early growing the summit of the root above the ground, and this habit may well form the beginning of another process of selection. In like manner to secure earliness in the cabbage we would select from rows of an early maturity that plant which first begins to leave the type common to the various races for the type impressed by art, and so on for other vegetables.

Lysimeter.

The lysimeter percolations have been carefully kept throughout the year. From the records here published it will be seen that stirring the ground tends to prevent evaporation. Until longer records than one year have been kept it would be unwise to discuss the meanings of this year's observations, as our conclusions would almost certainly require modification from a larger experience.

We append the following table of results to date:

1882.	Rainfall.	No. of days rainfall recorded.	Lysimeter Water Collected. Sod.	Bare soil.	Cultivated soil.
	Inches.		Inches.	Inches.	Inches.
August	2.371	10	.000	.135	.575
September	1.251	6	.000	.001	.284
October	0.621	7	.000	.000	.001
November	1.220	7	.000	.009	.011
December	0.550	4	.000	.271	.249
1883.					
January	0.482	13	.007	.052	.006
February	1.441	13	.142	.000	.000
March	0.880	12	.001	.001	.001
April	1.580	11	.001	1.291	1.566
May	4.451	16	1.204	2.439	3.010
June	4.120	12	1.204	1.151	2.154
July	2.980	13	.006	.320	.469
August	3.470	9	.000	.959	1.352
September	2.120	10	.000	.227	.632
October	2.100	10	.083	.964	1.353
November	1.540	5	.935	.801	.935
December	0.730	11	.165	.043	.031

Climate of Geneva.

From the statistics published by Professor W. D. Wilson of Hobart College, in 1867, we derive some information concerning the climate of Geneva, N. Y. Latitude 42° 52′; longitude 77° 2′; height five hundred and sixty-seven feet above the sea level. The figures embrace observations continued for twelve years.

The hottest time in the day was usually about 3 P. M., *i. e.*, a little before in winter, and a little after in summer. The coldest periods were a little after midnight.

The hottest day by the general average was August 1, 73.29°; the hottest week was that ending August 5, 71.82°.

The coldest day in the general average was February 3, 19.09°; and the coldest week, the one ending February 11, 23.19°.

The average temperature computed for each day in the year, and the greatest and least heat during the twelve years, was as below:

	Average temperature. Deg.	Twelve years. Greatest heat. Deg.	Greatest cold. Deg.
January	25·29	65·0	—16
February	25·39	59·5	—18·5
March	32·26	72	—5
April	43·21	79	11
May	55·66	85	31
June	64·93	94	38
July	70·28	96·5	32
August	68·08	95·5	48
September	60·47	89·5	34
October	49·66	85	28
November	39·12	73	10
December	25·56	63·5	—5

The average for the season was:

Spring	44°.21	Autumn	49°.52
Summer	67°.68	Winter	25°.41.

The average for the year, gained by adding the average for each day, and dividing by three hundred and sixty-five, was 47°.20.

The hottest average for the day, 84°.7, was on July 20, 1854; the coldest average for the day, 14°.2, on February 6, 1855.

Winds.

Reckoning three observations per day, we have on the average about fifteen observations per month with no perceptible winds. The others for the year are distributed as follows:

	N. W.	N. E.	S. E.	S. W.
January	38 1-2	6	4 1-2	39
February	34 1-2	5	3 1-2	30
March	44 1-2	4	5	23
April	36 1-2	7	6	23 1-2
May	32 1-2	10	12	23
June	29	5 1-2	11 1-2	21
July	30 1-2	8	14	21 1-2
August	31 1-2	4 1-2	14 1-2	23 1-2
September	27	7 1-2	11	25 1-2
October	31	7	10	27 1-2
November	29	5 1-2	8	31
December	34 1-2	8	6	27

Rainfall.

The average rainfall is given in the following table:

	Inches.		Inches.
January	1·594	July	3·281
February	1·138	August	3·690
March	1·888	September	2·499
April	3·375	October	3·122
May	2·933	November	2·254
June	2·121	December	2·027
Total			30·922

Or, averaging the seasons:

	Inches.		Inches.
Spring	8·196	Autumn	7·875
Summer	10·092	Winter	4·759
Total			30·922

As a matter of general observation there is a frost in the last of May or the first of June, and the "Indian Summer" is well defined.

Professor Wilson's observations appear to have been taken at 7 A. M., 2 P. M. and 9 P. M.

The station observations for 1883 comprise the reading of the maximum and minimum thermometers at 7 A. M., as also the earth themometers in the morning, at noon and 6 P. M., but only during the open season.

Thermometer averages for 1883.

	Maximum. Deg.	Minimum. Deg.	Highest. Deg.	Lowest. Deg.
January	26·2	6·7	44	—9
February	32·8	11·6	48	—2
March	32·5	14·7	61	2
April	50·5	30·5	75	15
May	62·7	41·3	87	37
June	76·2	56·4	86·5	42
July	77·2	57·6	89	46
August	80·7	55	92	46
September	66·8	45·8	80	37
October	55	38·3	78	25
November	48·4	29·7	70	13
December	36·9	18	56	—7·5

The readings of the air and soil thermometers at 7–8 A. M. averaged as below:

	Air. Deg.	*Soil.* 1 inch deep. Deg.	3 inches deep. Deg.	6 inches deep. Deg.	9 inches deep. Deg.	12 inches deep. Deg.	24 inch's deep. Deg.
Apr. 12 to 30	38.	40.2	39.2	41.3	44.	44.4	44.4
May	47.6	49.2	48.2	48.9	50.9	51.1	49.4
June	62.9	63.8	62.2	62.1	63.7	63.8	60.6
July	64.4	66.4	64.4	65.1	67.5	67.9	66.4
August	59.9	62.5	61.8	63.6	66.3	67.	66.5
September	50.2	53.1	53.5	55.9	58.8	59.8	61.5

The noon readings averaged as below:

	1 inch. Deg.	3 in. Deg.	6 in. Deg.	9 in. Deg.	12 in. Deg.	24 in. Deg.
Apr. 12 to 30	52.	47.2	43.9	44.5	44.3	44.3
May	59.2	55.7	50.9	50.9	50.6	49.4
June	75.6	71.6	65.1	64.2	63.7	60.7
July	79.2	75.1	68.4	68.2	67.9	66.4
August	76.	72.2	66.7	66.8	66.8	66.4
September	66.3	62.8	58.8	59.3	59.7	61.6

The 6 P. M. readings averaged :

	1 inch. Deg.	3 in. Deg.	6 in. Deg.	9 in. Deg.	12 in. Deg.	24 in. Deg.
Apr. 12 to 30...	50.4	49.4	47.2	46.8	45.8	44.2
May..........	57.7	57.	54.5	53.9	52.5	49.5
June	72.6	71.7	68.6	67.2	65.8	60.6
July...........	75.1	74.8	71.8	70.9	69.8	66.4
August	74.	73.8	71.3	70.3	69.1	66.2
September......	62.6	62.8	61.6	61.7	61.2	61.2

The average of the three soil observations differed in degrees from the mean of the maxima and minima air readings, as below :

	1 inch. Deg.	3 in. Deg.	6 in. Deg.	9 in. Deg.	12 in. Deg.	24 in. Deg.
Apr. 12 to 30..	+ 4.8	— 4.8	—22.2	—22.3	—23.0	—12.
May..........	+12.7	+ 3.6	—14.9	—15.5	—16.4	— 6.9
June..........	+28.0	+18.5	— 1.0	— 2.4	— 3.4	+ 4.3
July..........	+30.9	+21.4	+ 2.1	+ 1.5	+ 0.7	+10.1
August........	+28.1	+19.3	+ 0.9	+ 0.4	— 0.2	+10.1
September.....	+18.0	+ 9.7	— 7.5	— 7.5	— 7.6	+ 5.1

The last and first frosts were on September 30 and May 16, giving a season for 1883, of 137 days.

Range of soil temperatures.

Depth,	April 12 to 30.	May.	June.	July.	August.	September
1 inch,	32 to 66	39 to 73	53 to 86	59 to 89.5	54.5 to 87	43 to 78
3 inches,	32 to 59	37.5 to 65.5	51 to 80	58 to 84.5	55 to 85	44.5 to 74.5
6 inches,	36 to 50.5	40 to 68	51.5 to 77.5	60 to 78	57.5 to 78	49 to 70
9 inches,	39 to 53	43 to 66.5	55 to 71.5	63.5 to 76	60 to 75	53 to 68
12 inches,	39.5 to 50.5	43.5 to 59.5	55 to 70	64.5 to 74	61 to 73	54 to 66.5
24 inches,	42 to 46.5	43.5 to 54.5	54 to 64.5	64.5 to 70	63 to 68.5	57 to 64.5

Orchard.

The apple orchard, as found upon the station grounds upon our arrival, consisted of six hundred and ninety-five trees, most of which were of vigorous growth and of bearing size. It seemed desirable that the varieties of apple most worthy of being grown in our State should be represented by examples upon the station grounds. Hence, scions of the following varieties were obtained of Messrs. Ellwanger & Barry, and grafted upon thrifty trees on the orchard. The selection was made under the advice of Hon. Patrick Barry, a member of our board of control. The grafts were set in the order named, commencing at the northeast corner of the orchard, and following the rows south and north in turn.

Summer Apples.

Australian Red,
Large Sweet Bough,
Early Harvest,
Early Strawberry,
Golden Sweeting,
Keswick Codlin,
Primate,
Red June,
Sops of Wine,
Tetofsky,
Williams' Favorite,
Grand Sultan,
Geroskoe Selenke Gruner.

Autumn Apples.

Alexander,
Duchess of Oldenburg,
Fall Pippin,
Fameuse,
Gravenstein,
Haas, or Fall Queen,
Hurlbut,
Jefferis,
Jersey Sweet,
Maiden's Blush,
Munson's Sweet,
Pumpkin Sweet,
Red Bietigheimer,
Sherwood's Favorite,
St. Lawrence,
Stump,
Aunt Ginnie,
Blenheim Orange Pippin,
Fall Wine,
Menegere,
Reschestwenskoe,
Titouka.

Winter Apples.

Baldwin,
Bellflower Yellow,
Ben Davis,
Cooper's Market,
Dominie,
Fallwater,
Grimes' Golden,
Hubbardston's Nonesuch,
King,
Lady Apple,
Ladies' Sweet,
Lyman's Pumpkin Sweet,
Monmouth Pippin,
Mother,
Newton Pippin,
Northern Spy,
Peck's Pleasant,
Pewaukee,
Pomme Grise,
Rambo,
Rawle's Genet,
Red Canada,
Red Russet,
Rhode Island Greening,
Rome Beauty,
Russet, Golden,
Russet, Roxbury,
Seek-no-Further,
Spitzenburgh,
Sutton Beauty,
Talman's Sweeting,
Twenty-Ounce,
Vandevere,
Wagener,
White Pippin,
Wine Sap,
Brownlee's Russet,
Cox's Pomona,
Dumelow's Seedling,
Duke of Devonshire,
Lady Henniker,
Lord Suffield,
Melon,
Occident,
Ontario,
Reinette a feuilles d'Aucuba,
Reinette de Caux,
Small's Admirable,
Tuft's Baldwin.

Crab Apples.

Coral,
Hyslop's,
Large Red Siberian,
Oblong,
Transcendent,
Whitney's Seedling Siberian.

BULLETINS.

Bulletins reporting such matters as are of public interest in the Station work have been issued promptly once a week, and have been distributed in slips to such newspapers as have made applications. We have, in exceptional cases, reported communications from specialists which have seemed of public interest, as from Dr. B. D. Halsted, in

Bulletin LIV, upon the peach curl. We also gave circulation to Professor Lintner's circular upon the ravages of the chinch bug in Northern New York, on account of its public importance.

Among the papers which have come under our observation, we gladly note the following as having made use of the Station bulletins in whole or in part:

Agricultural Epitomist, Watsontown, Pa.
American Dairyman, New York, N. Y.
American Farmer, Baltimore, Md.
American Garden, New York, N. Y.
American Grange Bulletin, Cincinnati, O.
American Rural Home, Rochester, N. Y.
Avoca Advance, Avoca, N. Y.
Chautauqua Farmer, Dunkirk, N. Y.
Clyde Times, Clyde, N. Y.
Colman's Rural World, St. Louis, Mo.
Conger's Journal, Groton, N. Y.
Cultivator and Country Gentleman, Albany, N. Y.
Delaware County Dairyman, Franklin, N. Y.
Farm and Home, London, England.
Farmer, Malone. N. Y.
Farmer and Dairyman, Syracuse, N. Y.
Farmers' Advocate, London, Ont.
Farmer's Review, Chicago, Ill.
Gardeners' Chronicle, London, England.
Geneva Advertiser, Geneva, N. Y.
Geneva Courier, Geneva, N. Y.
Geneva, Gazette, Geneva, N. Y.
Geneva, Miscellany, Geneva, N. Y.
Home and Farm, Augusta, Me.
Husbandman, Elmira, N. Y.
Ithaca Daily Journal, Ithaca, N. Y.
Jamaica Standard, Jamaica, N. Y.
La Nueva Era, Roque, Cuba.
Lockport Daily Journal, Lockport, N. Y.
Maryland Farmer, Baltimore, Md.
Massachusetts Plowman, Boston, Mass.
New England Farmer, Boston, Mass.
New England Homestead, Springfield, Mass.
New York Weekly Observer, New York, N. Y.
New York Weekly Times, New York, N. Y.
New York Weekly Tribune, New York, N. Y.
New York Weekly World, New York, N. Y.
News and Courier, Charleston, S. C.
Ontario County Times, Canandaigua, N. Y.
Orange County Farmer, Port Jervis, N. Y.
Pacific Rural Press, San Francisco, Cal.
Phelps Citizen, Phelps, N. Y.
Planters' Journal, Vicksburg, Miss.
Post and Tribune, Detroit, Mich.
Practical Farmer, Philadelphia, Pa.
Rocky Mountain Husbandman, White Sulphur Springs, Montana.

Rural New Yorker, New York, N. Y.
Science, Cambridge, Mass.
Scientific American, New York, N. Y.
Southern Industries, Nashville, Tenn.
Springfield Weekly Republican, Springfield, Mass.
Times-Democrat, New Orleans, La.
Vick's Illustrated Monthly Magazine, Rochester, N. Y.
Washington World, Washington, D. C.
Weekly Press, Philadelphia, Pa.
Western Farmer, Madison, Wis.

Botanical Notes.

Double Embryos.

Tomato Seed. One double embryo noticed in germinating seed, of the Livingston's Perfection Tomato.

Onion Seed. Double embryos were observed in onion seed of the White Portugal, the Queen and the Flat Madeira varieties.

Parsley Seed. Out of one hundred seed of the Extra Double Curled Parsley, two had double embryos.

Abnormal Colytedens.

Egg Plant. Out of one hundred seedlings of each, the striped Guadaloupe, the Round Purple, the Blanche longue de China and White varieties had single plants with three seed-leaves; the Yellow had four such plants, and the Tomato Formed Red, three.

Tomato. Out of one hundred seedlings of each, the Boston Market and Hathaway's Excelsior had one plant each with four seed-leaves, and several other varieties had plants with three.

Cabbage. In seedling cabbages occasionally but one seed-leaf appears. In one case noted, the terminal bud issued from the base of the single leaf, splitting the leaf to gain room.

Variety in Seedlings.

Tomato. In Keyes' Early Prolific, the first leaves are entire; in the New French Upright nearly entire; in most of the varieties quite pinate.

Strawberry. Seedling plants from seed of the Bidwell and Manchester varieties have some plants with but one leaflet instead of the normal three leaflets.

Cross-Fertilization.

Cabbage. The blooms of the cabbage, fertilized with pollen of the winter radish, and also others with pollen of the ruta-baga, formed pods of full size, but devoid of seed.

Corn. The maize plant shows in its kernels the influence of cross-fertilization of the same year. Some varieties seem to possess the power of resisting either cross-fertilization or the changes induced thereby.

Beans. The varieties of the Kidney bean cross-fertilize, as seed grown from plants which the previous year had been adjoining other varieties show mixture in their crop. Some varieties, as the Refugee and the

Galega, seem to come true, even when surrounded by other varieties while growing.

Tomato. Last year flowers of the Turk's Cap variety were fertilized with pollen from the larger varieties, such as the Acme, Mayflower, Trophy and Paragon. These seeds planted in the green-house ripened in general smooth fruit. The seeds from the green-house fruit were planted in the spring, as well as those of the original saving.

Of the first generation, out of ninety-six plants in the open garden sixty-seven had smooth fruit, and twenty-nine bore fruit resembling the Turk's Cap in a greater or less degree.

Of the second generation, out of seventeen plants ten had smooth fruit and seven had fruit inclining toward the Turk's Cap.

On August 20, with a single exception, all the fruits that were ripening resembled the male parent.

In one instance a plant had fruit of the Turk's Cap and smooth type in about equal clusters.

Pea. In the cross of the Dwarf Gray Sugar pea bloom and the Day's Early Sunrise pollen, out of five plants three showed purple-tinged stipules.

Self-fertilization.

Pea. The stamens of all our varieties of the pea are polleniferous as soon as the clear white color of the petals appears and before the flower has obtained its full size and opened. The pea, hence, self-fertilizes. As occasionally peas off of type are borne, and as bees occasionally struggle with the flower, we must suppose that infrequently a cross-fertilization must take place.

No Fertilization.

Pea. It seems that the pea blossom will frequently be followed by pods, but not bearing seed, when the stamens are removed before the pollen has formed, even in cases where no pollen is applied to the stigma.

Position of Seed.

Turnip. In the Red Top Strap-leaf variety the seeds from the terminal blooms were distinctly larger than those from the lower branches. A fair sized plant produced in all 1 7-16 ounces of seed.

Sunflower. Plants from seed taken from axillary flowers had narrower leaves, and were of a lighter green than plants from seed taken from terminal flowers.

Sorghum. The Sorghum seed ripens from the summit downward. In germination trials the terminal seed sprouted more plants than did the seed from the central or lower portions of the head.

Corn. The terminal kernels of flint maize gave to our trials a stronger germinative and vegetative power than the central or butt kernels.

Immature Seed.

Maize. Flint corn, sweet corn and dent corn, harvested before glazing or hardening and brought to the house, germinated kernels freely while still on the cob.

Waushakum flint corn harvested just at the point of glazing, husked and hung up to dry, continued the ripening process so that at last it would not be suspected but that our samples had thoroughly ripened in the field.

Pea. Peas planted when at edible maturity vegetated as well as ripe seed.

Mutilations.

Corn. Corn plants of the Waushakum variety, cut off at the surface of the ground when five inches tall, received no injury, but continued their growth. A second cutting, when the plant had again attained five inches, did no apparent harm. A third cutting, however, appeared to enfeeble the plants.

Variation.

Tomato. The number of cells and the proportion of fresh seed and pulp are not constant in varieties of the tomato, nor are the number of petals and sepals to the flower. On September 10 we gathered ten fruits of Livingstone's Favorite, and found the following weight in grammes:

No. of cells.	Weight in grammes of Fruit.	Weight in grammes of Pulp and seeds.	Per cent of pulp, etc., to fruit.
9	225	60·90	27
7	197	41·90	21·2
6	179	43·20	24·1
7	175·2	35·50	20·2
7	164·55	29·90	18·1
5	162·50	38·20	23·5
7	126·50	12.00	9·5
6	83·55	8·50	10·2
4	74·70	7·20	9·6
4	56·90	5·15	9·0

Onion. A single stem of the White Portugal onion (which grew from a bulb produced by a plant which went to seed last year), formed bulblets upon the summit, together with seed.

In the case of a fracture in the stem of a plant of the same variety of onion a seed-bearing cluster grew out of the fracture.

Plants of the Top Onion formed seeds together with bulblets.

Biennials changing to annuals.

Last year plants of Scorzonera, Salsify and Carrot formed seed, and hence were annuals. This annual seed this year produced annual plants.

Wild carrot seed collected from plants in the adjoining field produced in every case annual plants.

Cauliflower in several cases flowered, but the season was not sufficiently long to produce seed.

Miscellaneous.

Potato. A potato grafted on the tomato produced tubers above ground just above the graft.

The wild potato, Solanum tuberosum, var. boreale, the seed from Arizona, and gathered and presented by J. G. Lemmon, of Oakland, Cal., yielded no tubers larger than those planted. The tubers were borne very diffusely, and were of the size of small hazelnuts.

The flowers in the majority of varieties are sterile in consequence of a lack of pollen. The Chicago market variety, the flowers of which produced no pollen, fertilized with pollen from the Tyrian Purple, yielded fruit in eleven cases out of twelve.

Salsify. About Geneva the Salsify is found as an escape along the roadsides.

Cow pea. Upon the land occupied by the cow pea last year cow peas were found as weeds.

Sorghum. Sorghum also appeared as a weed upon ground occupied by sorghum last year.

Monstrosities.

Corn. On October 3 we received from E. H. Libby, Rochester, N. Y., a plant of Stowell's Evergreen Sweet corn, but twelve and one-half inches tall, well formed, of a vigorous green, leafy, and bearing three ears, two of which were well kernelled. These two ears were hermaphrodite, the ovule and stamens within the same glume. The tassel was normal, but had not yet bloomed.

We harvested one ear of New England twelve-rowed, very perfect, eight inches long, then one and one-fourth inches of tassel from the extremity, and at the end of the tassel another well-formed ear three inches long.

Maize.

In 1882 we received a small package of seed of the pod corn from Professor W. J. Beal, of Lansing, Mich. This seed was all podded, and when freed from its husks was all of uniform type, a yellow dent. Planted in the Station garden it furnished us with a number of ears, some fastigiate, others heavily husked, others lightly husked, and some free from husks. Some of the unhusked ears were red kernelled, the only mixture being kernels of red sweet; others had white, yellow and ordinary amber sweet kernels. During the growth we noticed that wherever a plant was bearing the typal form of husked grain the tassels were heavy, branchy, and usually bore more or less podded kernels.

The fastigiate ears were those in which instead of husked kernels, numerous husked ears were borne, arranged parallel with each other from the base. In many cases the fastigiate kind and the typal kind occurred in the same ear, but these fastigiate ears were too late to furnish crop. In the normal type, many ears were very broad at the

base, tapering rapidly to the apex, others were cylindrical, and these latter were more lightly husked. In some cases twin kernels appeared in a pod.

In no case were sweet kernels found in the podded ears examined, and in neither the podded or bare ears were flint kernels to be found, although sweet kernels were abundant on the unpodded.

From our museum samples, we know that flint varieties of this pod corn exist, although we had no flint kinds sufficiently fresh to vegetate their seed.

This curious sort of maize has many names, such as Pod corn, Husk corn, Wild corn, Oregon corn, California corn, Rocky Mountain corn, Texan corn, Cow corn, and has an interest as believed by some to be the original of our cultivated kinds. White, yellow, red and purple varieties are mentioned. Each kernel, in its normal form, is inclosed in a distinct covering, the whole ear also being enveloped in a husk, and the cob flimsy as compared with our cultivated races. This variety is figured by Bonafous, plate V.; by Lindley in the Journal of the Horticultural Society, 1846; by Klippart, Agriculture of Ohio, 1858; in the United States Patent Office Report, 1853, and elsewhere, and is spoken of by De Candolle in his Geograph-Botanique.

Unfortunately we were unable to obtain seed of varieties, consequently we used for this season's seed, kernels picked from ears of our last year's crop. Of this we found fourteen kinds sufficiently distinct in color, surroundings or place of growth, and planted in all twenty-seven rows of four hills each. The following statistics of growth may prove of interest, the days of bloom before silk being for the earliest plant in each row:

From unhusked ears.	No. seed planted.	No. seed grew.	Proterandrous.
1. Red kernels	48	32	2 and 3 days.
2. Yellows kernels	48	44	1 and 3 "
3. Speckled kernels	48	34	1 and 2 "
4. Sweet corn, tinged with red	48	12	2 and 3 "
5. Sweet corn, striped with red	48	10	1 and 4 "
From podded ears.			
6. Yellow, kernels, partically husked	48	20	1 and 2 "
7. Yellow kernels, brown pods	48	24	1 and 2 "
8. White, red tinged, kernels, white pods.	48	44	2 and 2 "
9. White, purple striped, kernels	48	34	3 and 5 "
10. Yellow kernels, heavily podded	48	3	3 and 3 "
11. Yellow kernels from fastigiate ear	48	8	1 and 1 "
12. Pinkish kernels, twins in the pod	24	13	0 "
13. Red tinged kernels, tassel corn	40	13	1 and 3 "
14. Red tinged kernels, tassel corn	48	7	1 and 8 "

The planting was May 16; for the rows, the earliest and latest heading July 27 and August 7; the earliest and latest bloom August 2 and 20; the earliest and latest silking August 5 and 27. In making these observations, the earliest plant in each row, and the same plant for the bloom and silk was noted. In generel the pollen fell freely for about three to four days after its first appearance.

We note that in these plants in one case the pollen and the silk developed the same day, and in the remaining cases the pollen was

found from one to eight days before the silk emerged, so that from the duration of the pollen, self-fertilization in most of the cases was possible. We also would call attention to the great range between the plants in their period of maturing.

In sixteen rows the anthers were purple and the silk green, in one row the anthers both green and purple and the silk green, in ten rows not noted.

In twenty-six rows smut occurred to a large extent — in one row our record deficient. The location of the smut was in the thirty-three cases recorded, on the tassel in thirteen, the stalk in eight, the nodes in four, the leaves in three, the suckers in two, the ear in two, and the root in one case, but more than one location often in each row, or on same plant.

The yield in number of ears was:

Unpodded Seed. Series.	No. plants.	Podded ears.	Unpodded ears.
1	32	1	19
2	44	3	21
3	34	4	29
4	12	..	16
5	10	2	8
Podded Seed. Series.			
6	20	6	6
7	24	9	2
8	44	8	12
9	34	10	5
10	3	9	..
11	8	9	..
12	13	4	4 (1 tassel ear.)
13	13	11	..
14	7	10	..

		Yield.		
	No. plants.	Podded ears.	Unpodded ears.	Tassel ears.
Unpodded seed	132	10	93	..
Podded seed	166	76	29	1

Unpodded seed, ten rows, smut in nine rows.

Podded seed, seventeen rows, smut in seventeen rows.

Character of Unpodded Ears.

Series.

1. Fourteen ears red dent, two white dent, three ears yellow and white dent, some sweet kernels in all.
2. Twenty-one ears yellow and white dent, some sweet kernels.
3. Twenty-nine ears yellow and white and red blotched.
4. Sixteen ears white, yellowish and stripped dent, but some few sweet kernels, some of the ears mostly sweet.
5. Eight ears white, yellowish and red blotched dent, but some few sweet kernels, some of the ears mostly sweet.
6. Six ears white and light yellow dent kernels.

7. Two ears yellowish dent, with a few dark yellow kernels.
8. One ear red dent, one much pink, eleven ears white; yellow and red blotched kernels, with a few sweet kernels in all.
9. Five ears yellow, white and red blotched kernels, a few sweet.
12. Four ears white dent, with a few yellow dent and sweet kernels.

The number of rows to the unpodded ears is given below; the rows on the podded ears could not be counted in many cases, and hence are not given.

Series.	Rows on ear.	12	14	16	18	20	22	24	Total ears.
1	..	1	1	5	7	4	1	..	19
2	..	..	..	4	6	11	..	..	21
3	..	5	13	3	7	1	..	..	29
4	..	1	..	6	4	3	1	1	16
5	..	1	3	2	..	1	1	..	8
6	..	..	..	..	2	1	3	..	6
7	..	..	..	2	..	..	..	..	2
8	..	..	1	..	6	4	1	..	12
9	..	..	..	1	1	3	..	..	5
12	..	..	1	..	1	2	..	..	4

Although a yellow flint corn was growing beside these plants, yet it was generally out of bloom before silk appeared upon the pod variety, and in general this was the case with the other flint varieties grown, hence there was perhaps no cross-fertilization with the flints. There was a possibility of cross-fertilization from the dents and sweets grown in the garden, yet we noted no seed upon the ears differing in any respect from the last year's harvest, or from varieties grown alongside or at a near distance.

This variety of corn has many stay-roots, and requires hilling in culture in order to secure safety against winds. It is of a tall, vigorous, leafy growth, and seemed to us to furnish more available forage than any other variety grown by us. The prevalence of smut, probably a peculiarity of our seed supply, seems the only objection to its use for growing for forage purposes.

The plant is certainly too variable to be considered a wild species, and it also has parallelism of structure of the kernel with some of our cultivated races. The seeds of the Brazilian variety produce, according to Professor Asa Gray, both common and podded ears, as did our seed. The number of rows to the ear seems to furnish an argument against its being an aboriginal form of maize, for from the always finding even numbered rows, we should rather expect the original form to be distichous, in two rows only instead of from twelve to twenty-four rows; as also we should expect a smaller seed, and one less subject to destruction from insect ravages. The fastigiate ears may, however, furnish ground for the supposition that such was the earlier form, groups of ears of small size and imperfect kernelling, from which a single ear has been evolved through continual selections. Yet, in the present state of our knowledge, any definite conclusions in this respect would be hazardous.

Size of Seed-Kernel.

The influence of planting abnormally small kernels of a variety was tried in three cases. In the first case forty-eight seed picked from an

ear of Mammoth Dent on account of their very small size, were used. Of these, forty-seven grew and yielded twenty-six good ears, of normal size, and on type. In the second case some peculiarly small, round, streaked kernels, about the size of sorghum seed, were taken from the tassel of Waushakum corn. Planted seventy-nine seed, which furnished thirty-four plants. The yield, twenty-four good ears of normal size, and all of the Waushakum type, and of superior quality. Some few kernels slightly splashed with red, and a very few slate-colored kernels. In Sibley's Pride of the North, very small kernels; out of forty-eight planted, forty-seven formed plants, which yielded twenty-six good ears of normal corn, rather larger kernelled than the type. The effect of cross-fertilization, so many varieties being planted together, renders this trial inconclusive as to the influence of using small seed of its type upon the crop.

Dent Corn.

Twenty-five varieties of Dent corn were planted on May 16, two rows of four hills of each kind. Notes were kept of the number of seed that furnished crop of the blooming, silking, etc. We often observed a difference of several days in the progress in the maturing of plants in the same row. Hence our records refer to the earliest appearance of the bloom and the silk of the same plant; one for each row; and our table gives the earliest appearance for each row. We arrange the varieties in accordance with the appearance of the bloom, although there is no apparent relation between earliness here and in the crop. Several varieties, whose seed came from southern sources, were too late to even bloom. The seeds were planted on May 16, and the progress is reported in days from this date.

SEED.	No. planted.	No. plants grew.	Headed, days.	Bloomed, days.	Silked, days.	No. good ears.
1. Adams' Early White	24	19	57	62	63	14
do	24	19	55	74	74	14
2. Minnesota Dent, full round kernels	24	10	58	64	66	9
do	24	14	58	68	70	13
3. Sibley's Pride of the North, red-striped kernels	24	24	58	66	69	14
do	24	23	62	75	76	8
4. Sibley's Pride of the North, normal kernels	24	20	58	67	67	17
do	24	23	58	67	67	20
5. Minnesota Dent, yellow, long kernels	24	9	59	68	70	8
do	24	9	59	68	70	8
6. Minnesota Dent, reddish seed	24	19	62	68	70	16
do	24	19	62	68	70	18
7. Minnesota Dent, yellowish seed	24	23	63	71	72	14
do	24	22	63	73	76	8
8. Minnesota Dent, light yellow seed	24	21	63	71	73	8
do	24	19	62	71	71	11
9. Sibley's Pride of the North, small kernels	24	23	62	75	76	8
do	24	24	62	73	76	18
10. Minnesota Dent, reddish seed	24	22	62	73	75	9
do	24	18	61	73	76	9
11. Benton Dent	24	19	66	80	84	16
do	24	19	66	77	82	13
12. Early Dent, reddish kernels	24	1	63	77	79	2
do	24	2	72	87	87	2
13. Blount's Prolific, yellowish kernels	24	12	71	77	82	?
do	24	13	71	82	83	19
14. Early Dent, yellowish kernels	24	11	71	82	85	13
do	24	4	71	86	86	5

SEED.	No. planted.	No. plants, grew.	Headed, days.	Bloomed, days.	Silked, days.	No. good ears.
15. Minnesota Dent, red-striped seed	24	2	76	83	83	4
do	24	2	72	83	86	6
16. Wysor's Early Shoe Peg	24	22	73	84	90	?
do	24	22	75	82	91	18
17. Bessarabia	24	11	76	89	90	8
do	24	19	75	85	89	6
18. Kentucky Dent, white kernels	24	23	75	86	89	11
do	24	24	79	89	94	14
19. Kentucky Dent, yellow kernels	24	24	76	86	90	11
do	24	24	79	89	92	6
20. Chester County Mammoth	24	2	71	86	89	2
do	24	5	71	86	89	9
21. Indian Mound, Ark., ripe seed	24	20	90	95	101	unripe
do	24	21	82	95	99	unripe
22. Little Red Cob	24	20	95	99	105	unripe
do	24	18	95	98	105	unripe
23. Indian Mound, Ark., unripe seed	24	18	95	98	99	unripe
do	24	19	93	97	99	
24. Venezuela Corn, yellow	24	1	116	?	?	
do	24	0	....	....	....	
25. Venezuela Corn, white	24	15	116	?	?	
do	24	9	116	?	?	

In these forty-six rows we note, that the bloom and the silking occurred at the same time in seven rows, while in thirty-nine rows the bloom occurred in from one to nine days before the silk. If we consult the varieties, Sibley's Pride of the North bloomed and silked upon the same day in No. 4, silked in from one to three days later than the bloom in No. 3 and No. 9; Minnesota Dent silked before the bloom two days in Nos. 2, 5 and 6; from one to three days in No. 7; two to three days in No. 10; and from naught to two days and naught to three days in Nos. 8 and 15. Wysor's Early Shoe Peg No. 16 silked in from six to nine days after bloom, and the Indian mound corn Nos. 22 and 23 silked from four to six and four to seven days after bloom. The average appearance of the bloom was two and six-tenths days before the silk, the extreme being naught and nine days.

The amount of hybridization, and its character, is given in the following notes, the numbers referring to the varieties in the preceding table:

1. Ears mostly on type and color, a few yellow kernels.
2. Twenty ears on type, but some kernels not blotched; two ears of a flinty character.
3. Twenty-one ears on type, one ear appearing flinty; a few kernels blotched with red.
4. Thirty-four ears on type, three ears appearing flints; a few kernels blotched with red.
5. Sixteen ears on type, but yellow, white, pink, slate and red striped linty kernels prevalent.
6. Twenty-nine ears dent, five ears flint; kernels the proper color.
7. Eighteen ears dent, four ears flint; kernels yellow and white.
8. Nineteen ears dent, all on type.
9. Twenty-six ears normal, a few kernels blotched with red.
10. Eleven ears dent, seven ears flint; kernels yellow and white.
11. Twenty-nine ears, all on type; kernels yellowish and white.

12. Four ears, all on type; a few white kernels.
13. Sixteen ears dent, three ears flint; kernels white and yellow.
14. Five ears dent, thirteen ears flint; kernels yellow and white.
15. Ten ears, all on type.
16. Eighteen ears, all on type, but very unripe.
17. Fourteen ears, all on type; a few yellow kernels.
18. Eleven ears, all on type, but very unripe; a few yellow kernels.
19. Seventeen ears, all on type, but very unripe.
20. Eleven ears, all on type, but scarcely ripened.
21. Twenty-five ears, very unripe. One ear white, one ear reddish.
22. Eight ears, on type, but very unripe.
23. Twenty-one ears in all, very soft and unripe, two ears reddish, one ear yellowish white, the balance brown kernels.

The summary for the dents, omitting the unripe, is six hundred and two plants yielded four hundred good ears, and one hundred and thirty-two poor ears, or sixty-six hundredths good ears and twenty-two hundredths poor ears per plant. Six plantings out of twenty-three did not indicate hybridization; of these two, Minnesota Dent, No. 8, and No. 15, ripened, while Nos. 16, 19, 20 and 22 were very late.

Flint Corn.

Twelve varieties of flint corn were planted in twenty-three rows, and careful record kept of the progress and yield, as given below, the planting May 16.

	No. planted.	No. grew	Headed days	Bloomed days.	Silked days.	No. good ears.
1. Forty Days Early White	24	21	[illegible]	[illegible]	65	34
do	24	19	53	62	65	
2. Eight-rowed Brown	24	13	56	62	67	17
do	24	14	56	66	[illegible]	13
3. Eight-rowed, red glazed	24	19	58	[illegible]	[illegible]	14
do	24	19	56	68	71	17
4. Waushakum. Home seed	24	19	59	68	71	16
do Station seed	24	24	63	70	72	21
5. Improved King Philip	24	24	61	68	69	18
do	24	23	58	68	71	13
6. New England twelve-rowed	24	2	61	68	76	1
7. White Flint	24	20	61	68	71	17
do	24	13	61	70	72	11
8. Red Nose White	24	24	61	78	78	18
do	24	24	61	69	69	17
9. Early Dutton	24	20	57	70	71	15
do	24	19	62	69	[illegible]	14
10. Eight-rowed Purple Flint	24	20	68	75	80	10
do	24	20	[illegible]	70	75	13
11. Rural Thoroughbred	24	9	73	84	90	10
do	24	7	75	84	90	5
12. Caragua	24	19	86	94	97	9
do	12	7	86	96	97	2

In these twenty-three rows, the bloom and the silk was coincident in two cases, while the silk was from one to eight days behind the bloom in the remaining cases. The average appearance of the bloom was 3.35 days in advance of the silk, the extremes being naught and eight days.

The amount of hybridization, and its characters is given below:

1. Thirty-four ears, all flint; yellow kernels, white kernels, and pink striped and stained.

2. Thirty ears, all flint; some ears copper red, others yellow in shades; some kernels splashed with red, and some slate color and black flint.

3. Thirty-one ears, all flint, in general yellow, but some copper red; some kernels white, slate, red in shades, and splashed.

4. Home seed; sixteen ears, all on type, bright yellow. Station seed; twenty-one ears, all on type; a few slate colored kernels, and kernels splashed with red.

5. Thirty-one ears, all flint, some yellow, some red blazed, some copper yellow; many kernels black, slate, blotched and speckled.

6. One ear yellow flint with white kernels intermixed.

7. Twenty-eight ears, all flint, white and yellow kernels in about equal number, some splashed with pink, and one black.

8. Thirty-five ears, all flint; colors of kernels very much mixed, including white, yellow, pink, purple and blotched.

9. Twenty-nine ears, all flint; some slate colored, white and red splashed kernels.

10. Twenty-three ears, all flint, of which ten were purple, eleven yellow, one copper yellow and one red striped.

11. Fifteen ears, all flint; occasionally a yellow and a blue kernel.

12. Eleven ears, all flint, but very unripe.

The summary for the flints, omitting the unripe, three hundred and seventy-three plants yielded two hundred and ninety-four good ears and forty-three poor ears, or seventy-eight hundredths good ears and twelve hundredths poor ears to a plant. One planting out of the eleven showed no hybridization.

Sweet corn.

Twenty-seven varieties of sweet corn were planted May 16 in forty-nine rows. The records of progress and crop are given below:

	No. planted.	No. grew.	Headed days.	Bloomed days.	Silked days.	No. good ears.
1. Early Marblehead	24	16	53	57	56	19
2. Tom Thumb	24	18	55	62	62	16
do	24	18	53	61	62	20
3. Pratts Early	24	24	56	61	62	26
do	24	21	57	62	61	18
4. Early Narragansett	24	13	53	61	61	7
do	24	13	54	61	61	18
5. Early Minnesota	35	14	55	61	63	18
do	24	11	53	62	63	14
6. Dolly Dutton	24	21	53	61	64	24
do	24	17	53	61	64	19
7. Crosby's Early	24	9	61	66	68	14
do	24	12	57	66	68	14
8. Wyoming Sweet	24	20	62	69	72	41
do	24	17	58	68	68	17
9. Rochester	24	5	59	68	71	13
do	24	5	61	68	70	9
10. Moore's Early Concord	24	16	59	68	72	14
do	24	16	63	70	75	17
11. Golden Sweet	24	23	57	68	70	15
do	24	20	57	68	71	18
12. Extra Early Dwarf Sugar	24	22	62	68	71	14
do	24	22	62	68	71	21
13. Darling's Early	24	19	58	68	69	24
do	24	17	58	69	70	21
14. Early Orange	24	15	57	69	69	19
15. Excelsior Early Sweet	24	8	61	71	79	11
16. Squantum Sugar	24	12	58	72	72	20
do	24	13	66	79	84	18
17. Amber Cream	24	23	62	73	78	19
do	24	24	62	73	78	14
18. Sweet Asylum	24	11	66	75	79	9

	No. planted.	No. grew.	Headed days.	Bloomed days.	Silked days.	No. good ears.
19. Earley Eight-rowed Sugar	24	23	63	75	80	18
do	24	22	62	75	78	18
20. Hickox Improved Sugar	24	10	72	82	84	9
do	24	15	72	76	82	12
21. Black Sugar	24	12	63	76	76	21
do	24	15	63	76	78	12
22. Black Mexican	24	15	63	76	78	16
do	24	14	63	77	79	17
23. Stowell's Evergreen	24	13	68	80	84	11
do	24	12	66	78	85	13
24. New Triumph	24	15	71	80	84	13
do	24	13	71	78	81	12
25. Mammoth	24	1	68	82	83	1
do	24	6	68	82	86	13
26. Egyptian Sweet	24	2	72	82	84	5
27. Ne Plus Ultra	94	11	72	86	87	9
do	24	12	72	83	85	22

We note that of the forty-nine plants observed two silked before the bloom, in eight the silking and blooming were coincident, and in thirty-nine the bloom preceded the silk by from one to eight days, the average being 2.4 days.

The amount of hybridization, and its character, is shown, as before, under the numbers used above.

1. Seventeen ears amber white, two reddish ; some yellow flint, white flint, slate colored soft, and red blotched sweet kernels.

2. Thirty-six ears sweet corn, but yellow, white, slate, pink striped kernels of a flint and soft type, and sweet kernels splashed with pink.

3. Forty-four ears sweeet corn, but yellow, blue, white, purple and mixed kernels of a flinty type.

4. Twenty-five ears, in color from amber to red, sweet type, some flint kernels of a white, yellow and reddish color.

5. Thirty-two ears, sweet type, but red blotched sweet kernels, yellow flint, and slate and purple softs.

6. Forty-three ears, all sweet ; a few yellow flint, white flint and black sweet kernels..

7. Twenty-eight ears sweet type; some purple, slate, white sweet kernels, and yellow, white, slate and purple flint or soft kernels.

8. Thirty-one ears, sweet type; many yellow, white, slate color and pink striped flint kernels, and red splashed sweet.

9. Twenty-two ears, mostly sweet type ; but some so mixed that the flint predominates; yellow, blue, purple, white and red striped flint kernels, and some brown sweet kernels.

10. Thirty-one ears, sweet type; some white, yellow and pink flint kernels, and blue soft kernels.

11. Thirty-three ears, mostly golden sweet ; some yellow, slate and purple flint or soft corn kernels.

12. Thirty-five ears, sweet type; some white, blue, purple and slate kernels of flint and soft types.

13. Forty-five ears, sweet type; some red striped and slate sweet kernels, yellow, slate and purple flint kernels.

14. Nineteen ears, sweet type; amber, white, yellow, red blotched kernels of sweet type, yellow, white and slate of flint type.

15. Twenty-one ears, sweet type; some white and yellow flint kernels.

16. Thirty-eight ears, sweet type ; some white, yellow and purplish flint kernels.

17. Thirty-three ears, sweet type; some white slate and black sweet kernels, and yellow flint.
18. Nine ears, sweet type; a few yellow sweet kernels.
19. Thirty-six ears, sweet type; some yellow flint and blue and purple soft kernels.
20. Twenty-one ears, sweet type; some yellow sweet and yellow flint kernels.
21. Thirty-three ears, sweet type; some white, bluish and purplish sweet kernels, but most of the ears pure appearing.
22. Thirty-three ears, sweet type; a few kernels white, bluish and purplish sweet.
23. Twenty-four ears, sweet type; some few sweet kernels pink blazed, a few pink and blue sweet kernels, and a few yellow and white dent kernels.
24. Twenty-five ears, sweet type; a few purplish sweet, and yellow flint kernels.
25. Fourteen ears, sweet type; a few yellow flint kernels.
26. Five ears, sweet type; a few yellow flint kernels.
27. Thirty-one ears, sweet type; a few yellow flint kernels.

While these varieties showed mixture in every case, from this year's hybridization undoubtedly, yet it is worthy of note that no dent kernels were found, although carefully looked for, except upon one type of sweet; on the pod corn, sweet and dent were frequently to be found on the same ear, but these ears were of the same type as in the exception noted above.

The summary of the sweets show a yield of seven hundred and fifty-six good ears and one hundred and seventy-seven poor ears from seven hundred and thirty-six plants, or 1.03 good, and .23 poor ears to a plant.

Soft or Tuscarora Type Corn.

Of this class of corn we had growing the true Tuscarora, and various colored kernels selected from the mixed ears of the Mandan corn. It is worthy of note that although all the seed of the Mandan was taken from the same ears, yet the white kernels and the blue kernels failed to vegetate.

	No. seed planted.	No. grew.	Headed days.	Bloomed days.	Silked days.	No. good ears.
1. Mandan, Slate colored kernels.......	24	10	53	59	58	18
do	24	10	53	57	56	24
2. Mandan, Pink purple kernels	24	18	53	59	62	16
do	24	3	53	59	62	6
3. Mandan, Black slate kernels.........	24	6	53	59	61	12
do	24	6	53	57	56	12
4. Mandan, Speckled kernels......	24	2	53	64	64	4
do ,.....	24	2	53	61	68	4
5. Mandan, Yellow kernels	23	3	53	63	59	8
6. Tuscarora, White kernels...........	24	15	58	72	77	14
do	24	16	58	71	75	16

Of the eleven plants examined, we note the bloom from one to four days behind the silk in four cases, and the same time with the silk in one case, and from two to five days in advance of the silk in six cases, the average being 1.1 days.

The hybridization noticed is given below:

1. Forty-two ears, soft type, very much mixed in color, as yellow, white, slate, blue, pink, red, purplish and black in shades, many of which were flint.

2. Twenty-two ears, soft type, very much mixed in color of kernel, as white, yellow, blackish brown, slate color, copper red, pink, red and brown in various shades and stripes, many of which were flint.

3. Twenty-four ears, soft type, very much mixed in color of kernels, as yellow, white, slate, pink, copper red, purplish red in shades, and many of which were flint.

4. Eight ears, soft type, very much mixed in color of kernel, as yellow, white, pink, purple, blue, slate and splashed in shades, and many of which were flint.

5. Eight ears, soft type, prevailing color yellow, but much mixed with white, brown, slate, pink and purple kernels in shades, and many of which were flint.

6. Thirty ears, soft type, prevailing color to kernels white, but yellow and red blotched intermixed, and many of these kernels flint.

The summary of the yield is one hundred and thirty-four good ears and forty-two poor ears from eighty-six plants, or 1.55 good and .48 poor per plant.

The Mandan corn is the Squaw corn of the north-west, and not that grown by the Mandan Indians, as seems probable.

Pop Corn.

There are several types of pop corn ; the pop corn proper resembling a flint corn in all but size, and often in structure of kernel ; the pearl type with rounded kernels; and the rice corn, the kernels pointed and sharp. We present our data for each in turn.

Common Pop.

	No. seed planted.	No. grew.	Headed days.	Bloomed days.	Silked days.	No. good ears.
1. White, large kernelled pop...........	24	23	57	64	67	21
do	16	15	57	63	66	24
2. Large white pop, nearly a flint.......	24	23	58	65	67	18
do	24	24	58	65	65	21
3. New England pop, white............	24	21	57	66	73	36
do	24	18	61	70	75	33
4. White pop...	24	23	71	79	82	39
do	24	16	71	78	83	34

Of the eight plants noted, in one the bloom and the silk was synchronous, in seven the bloom was from two to seven days in advance of the silk; average, 3.5 days.

The description of the crop is given below.

1. Forty-five ears of pop, rice and pearl pop type, and also of, flint type, from four to eight and a half inches long; the kernels, some sweet, others yellow and white flinty.

2. Thirty-nine ears of pop, rice and pearl pop type, also flint from three to seven inches long ; one ear red, sweet kernels, yellow, white and red-striped pop and flinty kernels.

3. Sixty-nine ears, all on type, but some yellow kernels ; the ears from three and a half to seven and a half inches long.

4. Seventy-three ears, pop type and pearl type ; two red, the balance principally white; some yellow, white and amber kernels.

The yield was two hundred and twenty-six good ears and forty-two poor ears from one hundred and sixty-three plants, or 1.39 good and .26 poor ears to the plant. Smut was observed in seven of the eight rows.

Pearl Pop.

	No. seed planted.	No. grew.	Headed days.	Bloomed days.	Silked days.	No. good ears.
1. Wine yellow pearl pop	24	20	64	77	78	18
do	24	24	68	76	76	27
2. Red-tinged pearl pop	24	24	72	85	86	26
do	24	24	71	79	85	22
3. Pale-red pearl pop	24	17	72	83	86	28
do	24	20	72	84	86	20
4. Reddish blush pearl pop	24	17	72	83	84	21
do	24	20	71	85	87	33

Of the eight plants noted, the bloom and silk were synchronous in one case, the bloom from one to six days in advance in seven cases; average, two days.

The description of the crop is given below.

1. Forty-five ears, from pearl pop to flint; some white and red splashed kernels, but yellow prevailing. Length of ears from four to nine inches.

2. Forty-eight ears, all pearl pop red tinged, but a few yellow and dead white kernels. Length of ear from three to six inches.

3. Twenty-five ears, red and on type; twenty-three ears white, with a few yellow kernels. Length of ears from four to six and a half inches.

4. All the ears pearl pop; nineteen ears white, thirty-five blush pearl; a few yellow and red-blotched kernels. Length of ears from four to seven and a half inches. The yield was one hundred and ninety-five good and fifty-six poor ears from one hundred and sixty-eight plants, or one and sixteen hundredths good and thirty-three hundredths poor ears per plant. Smut was observed in four of the eight rows.

Golden Pop.

A variety noticeable from the diminutive size of the ears, many of which are often less than an inch long, and rarely over two and one-quarter inches. The color a bright yellow, the type approaching that of pearl pop, from ten to fourteen rows, very early and generally out of bloom before other varieties are in bloom. Of forty-eight seeds planted, thirty-six grew, thirty-two forming plants two feet tall, and four producing plants four feet tall. The heads appeared in fifty-three days from planting, the bloom in fifty-seven days, and the silk in fifty-three days, in this respect differing from our observations on other varieties. The fifty-two plants yielded fifty perfect and seven imperfect ears, from three-quarters of an inch to two and one-quarter inches long, all normal except one ear with a few sweet and flint kernels; the four larger plants yielded nine perfect and one imperfect ears, from three to five inches long, and not a pop-kernel to be seen, the kernels all either sweet, flint or Tuscarora. No smut was observed.

Rice Pop.

The ears from which the seed was obtained were all perfect in type.

	No. seed planted.	No. grew.	Headed, days.	Bloom'd, days.	Silked, days.	No. good ears.
1. Amber, red-tinged, large kernels	24	24	61	66	67	28
do	24	23	61	66	66	22
2. Dark red	24	19	58	70	73	18
do	24	20	58	69	72	23
3. Buff red	24	23	58	69	70	15
do	24	23	58	69	70	19
4. Yellow	24	23	59	70	71	16
do	24	24	61	70	69	15
5. Dark purple	24	17	64	70	72	18
do	24	11	62	72	73	13
6. White, red-streaked	24	24	64	72	75	14
do	24	21	64	70	71	16
7. Amber, red-tinged, medium kernels	24	20	64	73	75	13
do	24	24	64	73	73	19

Of the fourteen plants observed, in one case the bloom was one day behind the silk; in two cases the bloom and silk were synchronous; in eleven cases the bloom was from one to three days in advance of the silk; averaging 1.7 days.

The description of the crop is given below:

1. The yield of the first row, twenty-eight ears, were of rice, pearl and pop type, many of the kernels white and purple splashed, and some sweet. The twenty-two ears of the second row included five of the rice type, three of pop type, and fourteen of pearl type. Length of ears, three to nine inches.

2. Of the forty-one ears, ten were red pearl and pop, eleven red rice, one amber rice, three yellow rice, eleven pearl, and five nearly flint. Some skeet kernels and some few white and copper-red kernels in the ears of pearl type. Length of ears, five to eight inches.

3. Of the thirty-four ears, eight were red rice and one red pearl, six amber rice, and sixteen amber pearl, and three yellow pop. Some sweet kernels on all the ears. Length of ears, four to nine inches.

4. Of the thirty-one ears, nine were yellow rice, three purple rice, nine amber rice, four yellow pearl, and six ears flint corn. White, yellow and sweet kernels general in all but the red ears. Length of ears, three to eight and one-half inches.

5. Of the thirty-one ears, thirteen were purple rice, six buff rice, twelve amber rice. Length of ears, three to five and one-half inches.

6. Of the thirty ears, eighteen were rice, five pearl, and seven flint type, the colors various, but reds unmixed. Length of ears, three to nine inches.

7. Of the thirty-two ears, twenty-three were rice, four pearl and five flint type, the colors various, but the reds unmixed. Length of ears, two to nine inches.

The yield was two hundred and forty-nine good and twenty-nine poor ears from two hundred and ninety-six plants, or, eighty-four-hundredths good and ten-hundredths poor ears per plant. Smut was observed in ten out of the fourteen rows.

Hybrid Corn.

The only seed that we possessed that had been purposely cross-fer-

tilized was from Professor Lazenby, of the Ohio Experiment Station. The "Sweet crossed on Flint" seed was a yellow, broad dent kernel; the "Flint crossed on Sweet" was a small white flint kernel; the "Dent on Flint" was a yellow flint kernel, and the "Flint on Dent" was a yellow horse-tooth dent kernel. Planted May 16, the records read as below:

	No. seed planted.	No. seed grew.	Headed, days.	Bloomed, days.	Silked, days.	No. good ears.
1. Sweet on Flint....	24	23	58	72	73	23
do	16	15	61	69	70	15
2. Flint on Sweet....	24	24	63	70	71	16
do	24	22	62	72	75	17
3. Dent on Flint.....	24	22	68	78	80	8
do	24	24	65	73	80	13
4. Flint on Dent.....	24	22	62	72	72	14
do	24	22	63	72	72	20

The description of the crop is given below:

1. Thirty-eight ears covered with sweet and flint kernels, sweet and dent kernels, sweet and soft kernels. The colors, yellow, white, slate, purple and red-spotted, the sweet kernels amber. Length of ear, four and one-half to nine inches; three poor ears.

2. Thirty-three ears, covered with sweet and flint, and sweet and dent kernels. Kernels white and yellow flint, white and yellow dent, white purple tinged flint, white and amber sweet, slate and red-striped flint. Length of ears, four and one-half to nine inches; 10 poor ears.

3. Of the twenty-one ears, two were flint, nineteen were dent. Colors of kernel white, yellow, slate, purple and red-blazed. Length of ear four to nine inches; fourteen poor ears.

4. Thirty-four ears, all dent type; kernels yellow, white and red-blazed; no flint kernels, but a few flinty dents on one ear. Length of ear five to eight inches; eight poor ears.

Hybrid Corn.

In the varieties that follow, hybridity is assumed from the appearance or the position of the kernels used as seed.

Sweet Corn kernels from Pop-ear.

	No. seed planted,	No. grew.	Headed, days.	Bloomed, days.	Silked, days.	No. good ears.
1. Amber kernels from a large white pop ear.	24	19	58	63	64	20
do do	24	19	56	64	65	15

The ears were all sweet corn type, but white and yellow flint kernels interspersed, and sweet kernels on some of the ears of a rice type. Length of ear three and a half to eight inches; nineteen poor ears.

Sweet Corn kernels from Pearl-pop ears.

	No. seed planted.	No. grew.	Headed, days.	Bloomed, days.	Silked, days.	No. good ears.
1. Sweet kernels, amber-colored..... ...	24	16	61	66	69	9
do do	24	12	61	69	72	15
2. Dark red sweet kernels................	24	8	62	72	76	5

The description of the ears read:

1. Of the nine ears in the first row, five were rice pop, one pearl pop and three flint; of the fifteen ears in the second row, none sweet nor of rice type. The kernels yellow, white and amber, and an occasional dented kernel with the structure, but not the external appearance of a sweet corn. Length of ears three to seven inches; seven poor ears.

2. Of the five ears, one was a purple rice pop, the rest common pop type. Sweet kernels intermixed, purple on the purple ear, and some pink striped. Length of ears six to seven and one-half inches.

Sweet Corn kernels from a Rice Pop.

	No. seed planted.	No. grew.	Headed, days.	Bloomed, days.	Silked, days.	No. good ears.
1. Amber sweet kernel from a rice pop.	24	21	64	75	77	26

One ear a splendid flint corn, nine ears rice pop, sixteen pearl pop. Colors very much mixed, amber, yellow, white, pinkish blotched. Some few sweet kernels on the pop ears. Length of ears two to eight and one-half inches.

Flint kernels from Ears with Mixed kernels.

	No. seed planted.	No. grew.	Headed, days.	Bloomed, days.	Silked, days.	No. good ears.
1. Yellow kernels from a white flint ear..	24	16	63	69	73	11
do	24	13	58	69	70	10
2. Yellow kernels from a mixed with red flint ear...	24	19	61	72	73	12
do	24	15	61	68	75	..

The crop is described below:

1. Mostly a yellow flint, but some ears a dent, some white, slate and purple kernels, all of flint type. Length of ears, four to eleven inches; an occasional flint kernel on the dent ears.

2. In the first row, four ears with red striped kernels, eight ears yellow; some slate kernels. In the second row the ears mostly yellow, but some red splashed; some black kernels.

Flinty kernels from Dent ears.

This seed was not in general a true flint by structure, but had the appearance of flint, and perhaps in some cases was a flint.

	No. seed planted.	No. grew.	Headed, days.	Bloomed, days.	Silked, days.	No. good ears.
1. Flinty kernels from Minnesota Dent.......	24	16	68	76	76	10
do	24	9	69	76	78	8
2. Flinty kernels from Minnesota Dent, but small and red blotched	24	21	68	75	75	13
do	24	12	61	75	75	11
3. Lemon flinty from Blount's prolific white.	24	17	80	87	89	24
do	24	8	75	82	87	14
4. White flinty, from Blount's prolific white.	24	19	79	89	91	28
do	24	18	75	87	88	22
5. Red-yellow flinty from Pride of the North.	24	19	62	69	73	23
do	24	19	62	71	75	29
6. Yellow-flinty, from Pride of the North....	24	21	62	68	69	8
do	24	20	63	68	69	7

The descriptions of these crops are given below:

1. Eighteen ears on Minnesota Dent type, but some kernels splashed with red, and a few white and dark purple. Two ears have a flinty structure, but yet scarcely to be classed with flints. Length of ears, four to nine and one-half inches; four poor ears.

2. Twenty-four ears on dent type, but a few white, purple, pinkish, slate and blotched kernels. Length of ears, four and a half to eight and a half inches; two poor ears.

3. The twenty-four ears from the first row were all a yellow and white flinty dent, some few purple kernels; of the fourteen ears from the second row six were flint and eight dent. Length of ears, five to eight inches; four poor ears.

4. Of the fifty ears, fourteen were flint and thirty-six dent, the ears small; some yellow kernels. Length of ears from six to nine inches; twenty-one poor ears.

5. Of the fifty-two ears, eleven ears flint, forty-one ears dent type. Yellow mostly, but some black, slate, red-speckled kernels; one ear a copper-red. Length of ears five to eight and a half inches; six poor ears.

6. Of the fifteen ears, four ears flint, eleven ears dent. Color of kernels in general yellow, but some few slate-colored and red-striped.

Mixed kernels from Flint-ears.

	No. seed planted.	No. grew.	Headed, days.	Bloomed, days.	Silked, days.	No. good ears.
1. Yellow and red-striped....	24	22	65	77	80	18
2. Red and yellow-striped....	24	17	62	71	73	15
do	24	17	62	71	73	17
3. Red and yellow-blotched..	24	18	57	68	72	17

1. Of the eighteen ears, all flint, five were yellow and red-striped, thirteen were yellow, some few slate and blackish kernels. Length of ears, six to twelve inches; four poor ears.

2. Of the thirty-two ears all flint, nineteen were red and yellow-striped, thirteen were yellow. Length of ears from four to twelve inches; four poor ears.

3. The seventeen ears were all of King Philip type, in color from yellow to copper color; four poor ears.

Mixed kernels from Pearl Pop-ears.

	No. seed planted.	No. grew.	Headed days.	Bloomed days.	Silked days.	No. good ears.
1. Red and lemon mixed........	24	22	64	73	75	26
do	24	21	65	73	75	22
2. Red and white, small........	24	16	69	82	83	26
do	24	14	65	79	83	28
3. White and Lemon, red striped.	24	19	68	78	78	27
do	24	21	68	78	78	30
4. Dead White, white and red blotched..................	24	8	72	80	80	17
do	24	4	72	85	85	9

1. The ears of the first row all yellow pop, some few white and yellow red-blotched kernels, and sweet kernels. Of the twenty-two ears from the second row, four were rice-pop, eighteen pearl-pop, some kernels dead white, and some purple-blotched. Length of ears, four to seven inches; seven poor ears.

2. Of the fifty-four ears, most were pearl-pop, but some flint. Ker-

nels amber, white, yellow and some red-blotched. Length of ears four to eight and one half inches; seven poor ears.

3. The fifty-seven ears all pearl-pop, but yellow, white and red-striped kernels intermixed. Length of ears two to seven inches; three poor ears.

4. The twenty-six ears all pearl-pop, some kernels dead white, some few white, yellow and red-blotched. Length of ears from three to seven inches; four poor ears.

PECULIAR SEEDS.

Dark Red Pop-seed grown from White-seed.

	No. seed planted.	No. grew.	Headed, days.	Bloomed, days.	Silked, days	No. good ears.
1. Dark red pearl pop, from white seed....	24	18	62	73	75	27
do ...	24	22	62	73	75	26

1. In the first row ten were white, seventeen purple, both rice pop and pearl pop; some sweet kernels, both red and white. In the second row, seven ears were white, two yellow and seventeen red. Some red and white sweet kernels here and there.

Tassel Corn.

This means seed borne abnormally on the tassel.

	No. seed planted.	No. grew.	Headed, days.	Bloomed, days.	Silked, days.	No. good ears.
1. Small kernelled white seed from pop plant..	24	7	64	71	75	12

Two ears were rice pop, ten ears a pearl pop running toward flint. Two tassel ears. All kernels yellow. Length of ears, six to nine and one half inches; six ears ten-rowed; four ears twelve-rowed; one ear sixteen-rowed; and one ear eighteen rowed.

	No. seed planted.	No. grew.	Headed, days.	Bloomed, days.	Silked, days.	No. good ears.
2. Waushakum flint...	84	19	62	68	71	17
do ...	84	21	62	71	75	18

2 Of the seventeen ears from the first row, seven were dent, ten flint. The dent ears of Minnesota type, the flint of Waushakum. A very few white and slate-colored kernels, some slightly splashed with red. In the second row three ears of Waushakum flint type, one of common flint type, and fourteen dents. Some few white and red-striped kernels. Ears from four to nine and one-half inches long; eight poor ears in all.

	No. seed planted.	No. grew.	Headed, days.	Bloomed, days.	Silked. days.	No. good ears.
3. Waushakum, small. round, shrivelled striated kernels, reminding of sorghum kernels.......... .	55	16	56	66	69	18
do	24	18	58	68	73	16

3. All Waushakum type of ears, very handsome and perfect; a very few kernels slightly blotched.

	No. seed planted.	No. grew.	Headed, days.	Bloomed, days.	Silked, days.	No. good ears.
4. Blount's prolific....	24	11	85	95	99	17
do	24	6	76	89	95	2

4. The ears mostly on type, but a few yellow kernels. Very unripe. Length from five to eight inches; thirty-one poor ears.

We can make the following summary for some of the groups:

	Average bloom before silk days.	Extremes of bloom before or after silk days.	Yield per 100 plants. Good ears.	Poor ears.	No. of plants observed for bloom.	No. of plants observed for crop.
1. Dent corn........	2·6	0–9	66	22	46	602
2. Flint corn........	3·3	0–8	78	12	23	373
3. Sweet corn........	2·4	−1–8	103	23	49	736
4. Soft corn.........	1·1	−4–5	155	48	11	86
5. Pop corn						
Common pop	3·5	0–7	139	26	8	163
Pearl pop........	2·0	0–6	116	33	8	168
Rice pop........	1·7	−1–3	84	10	14	296
6. Hybrids, known....						
Various crosses ...	1·9	0–7	72	20	8	174
7. Hybrids, presumed.						
Flint on dent....	1·8	0–5	99	19	12	199
Flint on flint....	2·7	2–4	90	16	4	74
Pop on pop......	1·1	1–4	148	16	8	125

Seeds.

In the practical vegetation of seeds it is to be observed that but rarely all the plants grow, even from samples of known freshness, and of careful gathering and preservation. The cause of the failures may be ascribed to defective vitality or absolute abortion of individual seeds, as often as to unfavorable conditions of soil and temperature. It is also to be noticed that for the same species of plant there is a variety variation which applies as well to the vigor or quality of the seed as to change of form in the plant. It seems probable even that the vitality of the seed does not decrease proportionally with the distance from the time of harvest, as between varieties of a species; and there is also some reason to believe that in some cases old seed has as strong a germinative power as fresh seed.

As seed occupies such an important position in farming and gardening it seems desirable to investigate closely into its properties and peculiarities. For this purpose it has been customary to test the vitality of seeds by causing them to germinate and then compare the percentage of germinations. It seems probable, however, from duplicate observations made upon seeds, that the germative and vegetative properties do not correspond. and that many seeds develop a sufficient vitality to allow of the formation of a radicle, and yet insufficient for the development of the seed-leaf, the process which initiates growth, as distinct from metastasis. In our tables and assistant horticulturist's report will be found figures of the correspondences between germination and vegetation of seeds from the same package as purchased of seedsmen, and from the produce of the same plants as grown at the station.

Among the many curious observations which our table of results

justify is the apparent impossibility in all cases of obtaining duplicate results from seed selected as perfect from the same package. What these variations mean, and how they are to be interpreted we cannot yet say. One conclusion is, however, certain, *i. e.*, that as between two samples of seed of different origin the variations must be greater than that found to occur between duplicates before we can be justified in pronouncing in favor of the quality of the one sample over that of the other.

The seed selected for our "commercial trials" were furnished through the liberality of seedsmen, of whom we may mention here Messrs. Hiram Sibley & Co., of Rochester, J. M. Thorburn & Co., of New York, and Joseph Harris, of Rochester. These seeds have a special value as being of various ages, and representing seed taken from a large stock whereby individual plant differences have become eliminated.

Station Grown Seed.

In 1882 our germinating seed tests were made by placing the seed between dampened sheets of blotting paper, in saucers, and by planting upon soil kept moderately moistened. These methods, however, seemed to us troublesome, and in some cases even unsatisfactory. In undertaking our germination tests for 1883, guided by our past experience, we endeavored to secure a means of germinating seeds which might, while equally as reliable, yet possess ease of manipulation. The idea upon which our attempt was to be founded was the use of sand, kept moist through capillary attraction, as a seed bed, the keeping of the seed in a saturated atmosphere and yet exposed to the light and to observation.

For this purpose an apparatus was devised as follows: A twelve inch square earthern seed pan was filled with a fine sand, pressed in and the surface properly smoothened. This seed pan was then placed in a copper tray, one inch deep. Over the seed pan, and fitting within the tray, a copper box with a glass cover was placed. The seed, generally one hundred of a sort, were carefully counted and placed in parallel rows upon the surface of the sand and left exposed to observation. Water being supplied to the tray, capillary attraction kept the sand in the seed pan evenly moistened, while evaporation kept the air within the apparatus and in contact with the seed thoroughly saturated. Each day the rows of seed were carefully gone over, and such seeds as were found germinated, were counted as removed.

The only seeming objection that we have found to this apparatus has been the formation of mold upon the seed, but this mold, while rarely excessive in most cases, could be kept in check by a little care exercised in airing, and in regulating the water supply.

Among our first efforts was the obtaining of standards whereby the quality of seeds could be judged. It would not answer to use purchased seed, of whose freshness we could not be assured; we therefore confined our trials in this line to Station seeds, whose condition in regard to ripeness and preservation were well known. The seed in no case was selected individually from the packages, but represented the average of the harvest. The discrepant results between varieties was due, in many cases at least, to the seeding habit of the variety. Thus, the cucumber seeds used varied between the varieties in the number of

abortive seeds present, and the difference in the per cent of germinations is due rather to the per cent of empty seed cases present than to any lessened vitality of the true seeds. The influence of the condition of the plant from which the seed was gathered seems also to affect the germination percentage, hence the fairest trials must be with seeds gathered from a large number of plants. Thus, fifteen tests of onion seed, name and age unknown, received from Messrs. Hiram Sibley & Co., for germinative trials, gave an average germination per cent of eighty-four, the extremes being seventy-four and ninety-two. This compares favorably with the Connecticut experiment station trials of known, carefully selected fresh onion seed, from a seed grower, the average of thirty-three trials being eighty-seven and two tenths per cent. Per contra, in trials with Station seeds gathered from single plants variously treated, the normal plant yielded seed, of which sixty-eight per cent germinated; seed gathered from a compressed stalk germinated sixty-five per cent; seed gathered from a ligatured stalk germinated forty-six per cent; and seed gathered from a grafted stalk germinated fifty-three per cent.

The following table represents the result of germination trials from seed raised at the Station, and hence of known freshness and purity, as under one year old:

Beans.

	Per cent germinated.	One-half the seed germinated in days.	Total days of trial.
Navy or Pea	100	3	5
True White Pea	100	3	5
White Kidney	100	3	5
White Marrow	99	3	5

Corn, Flint Varieties.

Rice Pop-corn, white	100	7	9
do	100	4	13
do red	98	4	12
Waushakum	100	4	5
do	100	3	5
do	100	15	21
do	99	2	8
do	99	8	8

Corn, Dent Varieties.

Blount's White Prolific	96	5	12
Early Dent	58	4	10
Minnesota Dent	91	4	9
do	99	5	15
Sibley's Pride of the North	92	5	9
do	99	4	8
Sibley's Pride of the North	93	7	11
Duplicate	98	6	9

Cucumber.

Early Cluster	81	6	12

	Per cent germinated.	One-half the seed germinated in days.	Total days of trial.
[illegible]	55	7	12
[illegible]	69	6	12
Egg Plant.			
[illegible]	65	26	48
[illegible] Purple	2	11	17
Endive.			
Green Curled	13	7	18
Duplicate	13	5	18
Moss Curled	25	4	18
Duplicate	27	6	18
Grasses.			
Anthoxanthum ordoratum	52	7	17
Lolium Italicum	91	4	13
Bromus Schraderii	75	7	16
Lettuce.			
All the Year Round	83	2	6
Boston Curled	92	2	5
Brown Dutch	42	3	14
Brown Dutch	64	3	17
Duplicate	65	3	17
Duplicate	63	4	17
Curled Simpson	96	2	4
Hanson	95	3	8
Hanson	86	2	4
Ice Drumhead	97	2	4
New Orleans Green Cabbage	80	10	17
Tennis Ball	92	2	6
White Cabbage	90	3	6
White Cos	91	2	4
Melon.			
Hackensack	68	9	28
New Surprise	73	19	29
Onion.			
White Globe	68	5	12
Okra.			
Dwarf Green	2	10	43
Pea (free from weevil).			
Laxton's Marvel	99	4	6
Napoleon	100	3	6
Tall Sugar	100	3	6
White Marrowfat	100	3	6

	Per cent germinated.	One-half the seed germinated in days.	Total days of trial.
Peppers.			
Cherry Red	99	12	28
Large Bell or Bull Nose	90	11	34
Long Red Cayenne	95	16	33
Long Yellow Cayenne	78	16	36
New Cranberry	89	11	29
Oxheart	89	11	29
Small Red Chili	94	12	20
Squash or Tomato Shaped	95	9	26
Sweet Mountain	85	13	37
Sweet Spanish	97	16	37
Radish.			
Winter, Chinese White	88	4	12
Winter, California Mammoth	84	6	25
Turnip-rooted	99	3	3
Spinage.			
Prickly or Fall	86	5	14
Round or Summer	77	5	14
Tobacco.			
Turkish	71	5	12
Latakia	69	5	11
Havana	74	7	17
Tomato.			
Early Acme	93	5	8
Yellow Cherry	100	5	8
Mayflower	89	9	22
Paragon	88	9	22
Trophy	96	7	17
Red Cherry	92	12	31
Turk's Cap	78	12	40
Weeds.			
Amarantus Retroflexus	22	24	59
Chenopodium Album	8	15	18
Wild Carrot	4	7	10
Wild Parsnip	60	7	12

Seed Variations and Germinations.

Some plants furnish seeds of two different colors. Selecting from the mixed seeds the light colored and the dark colored, we note a difference in weight as follows:

Endive.

	100 Seeds Weighed. Light colored.	Dark colored.
Batavian	1.85 grs.	2.91 grs.
Green Curled	2.31 "	2.62 "
Moss Curled	2.31 "	2.70 "

Broccoli.

Cabbage	4.16 grs.	5.71 grs.
Carter's Summer	5.74 "	6.51 "
Early Purple Cape	4.08 "	4.93 "
Early Purple Cape (another sample)	4.01 "	5.09 "

Brussels Sprouts.

Imported Seed	3.31 grs.	4.16 grs.
Rosemary	3.85 "	4.93 "

Collards.

True Southern	4.16 grs.	5.40 grs.

Salsify.

Blue Flowered French	13.42 grs.	15.84 grs.

Cabbage.

Earliest Blood Red Erfurt	3.46 grs.	5.78 grs.
Netted Savoy	4.23 "	5.09 "
Schweinfurt, Largest White	3.46 "	5.78 "

Kale.

Chou Mille Tetes	5.86 grs.	7.40 grs.

The few germination trials with these seeds gave the following figures:

Endive.

	Per cent.	Per cent.
Moss Curled	32	16

Broccoli.

Early Purple Cape	79	92

Cabbage.

Earliest Blood Red Erfurt	74	77
Netted Savoy	83	98
Schweinfurt, Largest White	96	98

Kale.

Chou Mille Tetes	91	100

We may infer from this data that in these plants weight of seed and color of seed are correlated, and that the heavier seed in general germinate better than do the light seed.

A few trials were made of the germination of large and small seed, as compared with ordinary seed taken from the same package, resulting as below:

Winter Radish.

	Per Cent Germinated.		
	Large seed.	Ordinary seed.	Small seed.
Chinese White	91	86	..

Pea.

	Large seed.	Ordinary seed.	Small seed.
Pea	..	92	64

The influence of the position of the seed upon the plant has received apparently less study than its importance deserves. In experiments carried forward last year upon the butt, central and tip kernels of maize, the influence of position was extremely marked in favor of the greater crop capacity of the tip kernels. We have hence made a number of trials of the germination properties of seed selected with reference to their position. In the corn trials the tip kernels were manifestly lighter in weight than either the butt or central kernels, while in the sorghum the tip seeds were the heavier. Thus —

	Weight of, in Grains.		
	Lower kernels.	Central kernels.	Tip kernels.
One hundred kernels of Waushakum Corn	540.1	513.8	390.4
do do	550.9	499.2	394.2
Sorghum, Chinese No. 4	6.2	.....	12.5

Passing to our germination trials, we give the result in a table, which renders quite evident that the germinative vitality of the tip kernels are, in general, superior to that of the kernels in other positions. In germinating the seed the kernels were laid upon the surface of the sand in our apparatus; in vegetation trials the seed was buried beneath the surface.

GERMINATION AND VEGETATION.

	Position of Seed.		
100 Seeds of, Germinated Per Cent.	Lower.	Middle.	Terminal.
Waushakum Corn, Flint (germ.)	80	72	95
do (veg.)	80	76	92
do do	95	90	100
do do	95	97	100
White Rice Pop-corn (germ.)	100	100	100
Red Rice Pop-corn (germ.)	98	94	100
Minnesota Dent (germ.)	98	100	100
Early Dent (germ.)	82	24	33
Sibley's Pride of the North (germ.)	100	100	97
Blount's Prolific (germ.)	...	...	12
Wheat (germ.)	99	...	100
do	100	100	100
Oats (germ.)	94	88	100
do	100	100	100
Sorghum (germ.)	65	86	89

In the case of the Dent corns, some were under-ripe and the germination imperfect. Trials upon under-ripe flints and dents showed that while under-ripe flint has very strong germinative power, under-ripe dents have a weakened vitality.

An analogous illustration is to be found in the eyes of the potato—of four potatoes cut into single eyes, and the eyes planted in the order they occupied upon the tuber, the majority vegetated first from the eyes taken from the upper half of the potato. In a fifth potato the predominance of vegetation was in the lower eyes. Of one hundred and twenty-six potatoes allowed to sprout in a warm and dark place, the sprouts started from the upper half in one hundred and twenty-one cases, and from just below the median line in five cases.

We find a number of statements of other experimenters upon the subject. In Germany, Metzger states that the butt kernels of maize from a foreign and warm climate retained in Germany the character of the variety after the plants from the tip kernels had already begun to assume that character which, in the third generation, all the grains acquired. M. Chevreul declares that the butt kernels are better for seed than those at the top, but in this his experience seems counter to that claimed by the majority of observers. He says that in melon seeds the further they are from the peduncle the better they are. Authorities quoted by Darwin say that the last pea in the pod of a variety will revert to their origin quicker than the seed taken from the other parts of the pod; the seeds at the top of a spike of hemp produce more female plants in proportion to the male plants than do those lower down; aster seeds taken from the florets of the circumference yield the greatest number of double flowers; in stocks the upper part of the pod yields seed that give eighty per cent of single flowers, and hence this part is rejected by the florist who seeks double flowers; the lower, inner part of the lamina of the leaves of certain varieties of Scolopendrium ferns furnish spores which produce the normal parent form, while those spores produced on the outer abnormal part of the leaf reproduced the special varieties.

MUTILATED SEEDS.

It is difficult to define just what amount of mutilation will destroy the germinative vitality of seeds. The following trials will, however, serve to illustrate:

Peas, planted under surface:

Fifty perfect peas vegetated ninety-two per cent.

Fifty imperfect peas vegetated sixty-eight per cent.

Fifty injured by pea weevil vegetated fifty-six per cent.

Twenty-five shrivelled and diminutive vegetated sixty-four per cent.

It seems probable, however, that a variety difference exists which will not allow generalization from unnamed results.

Maize, planted under surface:

Ten kernels Waushakum Flint corn, cut lengthwise to bisect the germ, one vegetated.

Twenty kernels Waushakum Flint corn, more or less of the albumen removed, twelve vegetated.

Ten kernels Waushakum Flint corn, part of one edge removed, three vegetated.

Ten kernels Waushakum Flint corn, a small portion of the chit removed, care being taken not to injure the germ, none vegetated.

Bean, planted under surface:

Twenty beans with one cotyledon removed so as not to injure the germ, the germ portion planted, thirteen vegetated.

We may hence conclude that injury to the seed is very detrimental to the growth, yet not of necessity fatal.

Regerminations.

The continued vitality of seeds after drying, and the power they hence have to resist drought at planting time, is truly remarkable. For the purpose of testing this property seeds were sprouted in our apparatus, and then removed to a warm and dry place, where they were left until thoroughly dry, usually seven days, and then germinated. We arrange our figures in tabular form:

Corn.

VARIETY AND REMARKS.	Germination per cent each trial. I.	II.	III.	IV.	V.	VI.	Total days drying.
Waushakum Flint corn	100	97	97	65	20	0	47
Waushakum Flint, very ripe	99	93	67	9	0	0	28
Waushakum Flint, moderately ripe	99	99	74	22	46	..	28
Waushakum Flint, very green	100	97	47	11	0	..	28
White Rice pop corn	100	96	29	43	44	..	28
Sibley's Pride of the North	82	67	10	0	..	..	15
Sibley's Pride of the North	92	91	21	22	0	..	28
Minnesota Dent	91	61	14	50	0	..	28
Early Dent	41	87	12	0	..	..	21
Blount's Prolific, Dent	96	83	14	12	0	..	28
Average for Flint varieties	99·6	96·4	63	30	22	0	
Average for Dent varieties	80·4	78	14·2	21	0	..	

Wheat.

	Germination per cent each trial. I.	II.	III.	IV.	V.	VI.	VII.	Total days drying.
Upper kernels	99	100	100	100	97	97	100	42
Lower kernels	100	93	100	93	92	100	92	42

Peas.

First germination, ninety-six per cent.

Second germination, after nineteen days' drying, seventy-eight per cent.

Second germination, after seven days' drying, one hundred per cent.

Third germination, after seven days' drying, sixty-seven per cent.

Third germination, after twenty-six days' drying, 0 per cent.

Fourth germination, after seven days' drying, thirty-eight per cent.

Fifth germination, after seven days' drying, 0 per cent.

Bean.

	Germination per cent each trial. I.	II.	III.	IV.	Total days drying.
White bean	100	71	21	0	26

Radish.

	Germination per cent each trial. I.	II.	III.	IV.	V.	IV.	VII.	Total days drying.
Chinese White, large seed	92	98	100	88	55	66	82	42
Chinese White, ordinary seed	86	97	100	86	15	25	50	42

Onion.

White Globe, four hundred seed, first germination, fifty-eight per cent.

Second germination, after one day drying, seven seed planted, one hundred per cent.

Second germination after eight days drying, ninety seed planted, one hundred per cent.

Third germination after eight days drying, eighty-seven seed planted, ninety-three per cent.

Fourth germination after seven days drying, eighty-one seed planted, seventy-six per cent.

Fifth germination after seven days drying, sixty seed planted, thirty per cent.

Sixth germination after seven days drying, eighteen seed planted, 0 per cent.

Parsnip.

Wild parsnip, first germination, sixty per cent.

Wild parsnip, second germination, one day dried, 0 per cent.

Lettuce.

Mixed seed, five hundred planted, ninety-one per cent.

Second germination, three hundred and fifty-one planted, one day dried, ten per cent.

From these figures we may infer that corn, wheat, peas, beans, radish and onion seed have a vitality which will protect against many vicissitudes of soil relation to moisture, while parsnip and lettuce seed require to progress at once from germination to vegetation. This vitality is especially evident in wheat, and this explains the safety of the custom of fall planting, even before the droughts of the season have passed. In these seeds of regerminative vitality we have developed a drought-resisting power very gratifying to the planter.

The method in which growth is renewed is deserving of notice. Thus, in the maize and wheat, the descending axis usually dies, while the ascending axis resumes growth, throwing out rootlets from itself. In some cases, however, the descending axis retains its vitality and resumes growth. In the case of the onion and radish the growth was always resumed by the descending axis. In the bean growth was resumed by rootlets starting out from the descending axis.

Commercial Seed.

The apparatus used with the "Commercial Seeds" was designed by one of our assistants, Mr. A. B. Lovett. It consists of a copper box, ten by fourteen inches square, and three inches deep, with a glass cover sliding within grooves. About half an inch below the glass, upon the two long sides, a ledge occurs, upon which rest the wires which support the plaits of cloth which form pockets for the reception of the seed. These pockets are formed by inserting within hems a brass wire each two inches apart along a strip of cotton flannel, of a width to fit closely within the apparatus. When these wires are placed upon the ledges within the box, and pressed into contact, the fold between is compressed, and forms a closed receptacle or plait, the sides in contact. At the two extremities of the system the cloth reaches to the bottom of the box. Water is poured into the box to the depth of half an inch, and the cloth becomes saturated through capillary attraction, while the cover insures a saturated atmosphere. Each plait is numbered, and while slid open, receives the counted seed; the wires are then slid together, thus enclosing the seed in its damp pocket. An apparatus of the size given accomodates fifty pockets. Careful tests show that this method is a reliable one, as it certainly is a convenient one. We have furnished copies of our apparatus to the experiment stations at Houghton Farm, as also to the Alabama Station at Auburn, and to some seedsmen.

In the table of commercial seeds the age is as stated by the seedsmen, and is presumably correct.

VEGETABLES.	No. varieties.	No. samples.	Age of seed. year.	First seed sprouted: days.	Per cent germinated.
Artichoke	1	1	1	4	58
Asparagus	1	1	1	6	52
"	1	1	3	14	2
Basil, sweet	1	1	2	2	22
"	1	1	8	2	15
Bean	2	5	2	2	95
"	1	1	3	2	98
Beans, Lima	1	1	1	1	92
Beet	3	3	0	1	75
"	3	6	1	1	70
"	3	3	2	2	75
"	1	1	4	3	52
"	1	1	5	2	88
"	1	1	7	3	34
"	2	2	9	3	46
"	1	2	12	3	40
"	1	1	14	4	10
Boneset	1	1	2	16	1
Borage	1	1	5	3	58
Broccoli	1	1	1	2	55
"	2	2	2	2	76
"	2	2	3	3	59
"	1	1	4	3	55
Brussels Sprouts	1	1	1	2	70

VEGETABLES.	No. of varieties.	No. of samples.	Age of seed. year.	First seed sprouted: days.	Per cent germinated.
Brussels Sprouts............	2	2	2	2	80
Cabbage	2	2	0	1	73
"	20	28	1	1	82
"	21	45	2	1	72
"	10	11	3	1	66
"	2	2	4	1	85
"	3	3	6	3	11
"	1	1	8	..	0
"	2	2	10	..	0
"	1	1	11	..	0
"	2	2	16	..	0
"	1	1	17	..	0
Cardoon	1	1	1	3	74
Carrot......................	2	2	0	7	48
"	10	12	1	2	53
"	4	4	2	2	51
"	1	1	3	3	29
"	1	1	4	..	0
Catnip......................	1	1	8	..	0
Cauliflower.................	6	6	1	1	82
"	7	10	2	1	84
"	7	7	3	1	59
"	3	3	4	1	48
Celeriac....................	1	1	2	6	1
"	1	1	4	..	0
Celery......................	1	1	0	18	2
"	1	1	1	7	13
"	1	1	2	6	11
"	1	1	3	..	0
Cherrie	1	1	2	4	44
"	1	1	17	..	0
Chicory.....................	1	1	1	2	40
"	1	3	3	2	34
Collards....................	1	1	1	1	29
"	1	2	2	1	95
Coriander...................	1	1	1	4	50
Corn, Dent..................	1	2	1	2	95
" Sweet.................	1	3	1	2	85
Corn Salad..................	1	2	6	4	32
"	1	1	7	..	0
"	1	1	8	..	0
Cotton......................	1	1	1	3	70
Cress	1	1	1	1	98
"	2	2	2	1	89
"	1	1	3	1	87
"	1	1	4	..	0
"	1	1	6	2	70
Cucumber	5	9	1	1	77
"	1	1	2	1	17
"	1	1	4	2	56
"	1	1	19	2	14

VEGETABLES.	No. of varieties.	No. of samples.	Age of seed. years.	First seed sprouted: days.	Per cent germinated.
Dill	1	1	2	12	2
Dyer's Madder	1	1	2	..	0
Egg Plant	2	2	1	2	61
Endive	2	6	2	1	48
"	1	2	3	1	44
"	1	1	18	..	0
Jute	1	1	2	1	47
Kale	2	2	2	1	93
"	1	1	3	2	33
"	1	2	6	1	64
Kohl-rabi	1	2	1	1	82
"	1	1	2	2	87
"	1	1	3	2	94
"	2	2	4	1	45
Leek	1	2	4	3	21
Lettuce	20	27	1	1	82
"	13	17	2	1	73
"	7	8	3	2	87
"	3	3	4	1	69
"	1	3	5	1	97
"	3	8	7	2	36
"	1	1	9	..	0
Lupine	1	1	1	1	88
Mangold	1	1	0	2	82
"	1	1	1	2	76
"	1	1	3	2	52
"	1	1	5	5	16
"	3	3	7	3	31
"	1	1	8	3	36
Musk Melon	1	1	0	1	92
"	11	24	1	1	89
"	4	6	2	2	92
"	1	1	3	2	95
"	2	2	4	2	91
"	2	2	6	2	89
"	1	1	7	2	89
"	1	1	9	4	36
"	2	2	10	3	76
Mustard	1	2	2	2	81
"	2	6	3	1	90
"	1	2	10	2	5
Nasturtium	1	1	6	7	4
Oats	1	1	2	2	98
Okra	1	1	2	1	90
Onion	11	117	1	1	90
"	17	44	2	1	68
"	8	11	3	1	49
"	1	4	4	2	0 1-4
"	1	1	7	..	0
Parsley	2	2	1	5	77
"	1	1	2	6	86

VEGETABLES.	No. of varieties.	No. of samples.	Age of seed. years.	First seed sprouted: days.	Per cent germinated.
Parsnip	2	2	0	8	13
"	2	2	1	5	39
Pea	1	1	2	1	86
Peppers	2	2	1	2	71
"	1	1	2	3	73
"	1	1	8	..	0
"	1	1	9	2	3
"	1	1	10	..	0
Poppy	1	1	1	3	3
Pumpkin	2	5	1	2	69
Radish	27	47	1	1	70
"	8	11	2	1	61
"	4	4	3	1	70
"	3	3	4	1	63
"	1	1	5	2	20
"	1	1	7	3	3
Reana Luxurians	1	1	2	2	84
Rhubarb	3	3	4	3	72
Rosemary	1	1	6	..	0
Roquette	1	1	2	1	79
Ruta baga	2	5	1	1	96
"	7	80	2	1	94
"	3	9	3	1	73
"	5	6	4	1	70
"	3	3	5	2	56
"	1	1	7	1	52
"	1	1	9	..	0
"	1	1	11	..	0
Sage	1	1	1	3	63
Salsify	1	1	2	2	63
Savory Cabbage	5	8	2	1	85
"	1	1	5	3	33
"	1	2	6	2	43
"	1	1	7	2	32
"	1	1	10	..	0
Scorzonera	1	1	2	2	16
Sea Kale	1	1	1	..	0
"	1	1	2	?	24
Serradella	1	1	2	4	37
Soja hispida	1	1	3	5	1
Sorghum	3	3	1	2	45
"	1	1	2	2	63
"	2	2	3	2	80
Sorrel	1	1	13	..	0
Spinage	..	..	..	..	..
Spurry	1	1	1	1	65
Squash	1	1	0	2	92
"	8	18	1	2	72
"	7	10	2	2	70
"	4	4	3	2	72
"	1	1	6	5	10

VEGETABLE.	No. of varieties.	No. of samples.	Age of seed. years.	First seed sprouted: days.	Per cent germinated.
Squash	1	1	10	7	18
"	1	1	14	..	0
Sugar Beet	2	2	1	1	78
"	1	1	2	2	54
Thyme	1	1	2	3	25
"	1	1	7	..	0
Tobacco	1	1	2	7	12
"	1	1	3	6	67
"	1	1	4	5	59
"	2	2	5	5	64
"	2	2	7	5	36
"	1	1	20	..	0
Tomato	9	12	1	1	80
"	10	21	2	1	86
"	7	7	3	2	86
"	3	3	4	1	64
"	1	1	5	3	75
"	2	2	6	3	96
"	4	5	7	2	73
"	5	6	8	1	79
"	1	1	9	3	87
"	11	11	10	1	75
"	2	2	11	2	62
"	1	1	13	3	87
"	2	2	14	2	88
Turnip	6	73	1	1	87
"	12	32	2	1	95
"	10	24	3	1	93
"	6	18	4	1	77
"	4	4	5	1	94
"	3	3	6	2	58
"	2	3	7	2	52
"	2	2	12	2	49
Watercress	1	1	2	3	27
"	1	1	8	..	0
Watermelon	8	33	1	1	51
"	11	18	2	2	58
"	1	1	3	7	4
"	1	1	4	2	80
"	1	1	6	4	80
"	1	1	8	13	2
Welsh Onion	1	1	1	3	30
Whiltoof	1	1	6	2	35

Weight of Seeds.

In order to discover the laws which govern production and growth it is necessary to accumulate facts, some of which may prove of collateral importance in furthering the object in view. It seems quite possible that there is a relation between the weight of the seed and the quality of the product as between varieties of the same species, and it

is also possible that there is a relation between weight of seed and prolificacy of plant. In our first attempt we must expect to obtain more or less discordant results, on account of using purchased seeds which have undergone more or less selection for quality by the seedsmen in the way of winnowing and removing the imperfect ones. When, however, we come to weigh the seeds as collected from the plant, we shall expect to find certain discrepancies between the weight of different samples which may be caused by individual variation or by the influence of season. When the results of our weighings come to be compared with the products at harvest it is then possible that some relations may be found which do not now appear. We have expressed the weights in a column of grains, and in another column of grammes, as thus our weighings may be compared with the weighings of others who have adopted the one or the other system exclusively. In our arrangement we pursue the alphabetical system as far as may be done without separating the genera to which the species or varieties are assigned. In the larger number of cases one hundred seeds were actually weighed, in a few cases a less number than one hundred, on account of only having a small supply.

	Weight per 100 seeds. Grains.	Grammes.
Alkekengi.		
Petite Tomate du Mexique	2.16	.14
Sweet Yellow	1.54	.10
Angelica.		
Angelica	7.09	.46
Asparagus.		
Giant	29.62	1.92
Asperula.		
Asperula Odorata	9.41	.61
Balm.		
Balm	.92	.06
Barley.		
Kinver's Chevalier (Sta. crop)	82.56	5.35
Manshury (Sibley)	49.37	3.20
Sibley's Imperial (Sibley)	40.59	2.63
Beans.		
Algiers	927.8	60.12
Black Negro	486.8	31.5
Black Speckled	630.2	40.8
Blue Podded	632.7	41.0
California Branch	307.8	19.9
Carter's Champion Runner	1,651.2	107.0

	Weight per 100 seeds. Grains.	Grammes.
Dark Dun	554.8	35.9
Dwarf German Wax	589.5	38.2
Dwarf German Wax, long variety	500.0	32.4
Earliest White Seeded France	568.0	36.8
Emperor William	598.7	38.8
Flageolet Wax	887.3	57.5
Fulmer's Early	922.8	59.8
Giant White	1,753.0	113.6
Golden Drop	493.5	31.98
Golden Wax	679.0	44.0
Gray Seeded	546.0	35.38
Haricot d'Alger noir nain	649.68	42.1
Haricot d'Alger ou beurre boir	851.84	55.2
Haricot beurre du Mont d'Or	841.03	54.5
Haricot Countesse de Chambord	259.25	16.8
Haricot d'Espagne blanc	2,134.24	138.3
Haricot d'Espagne rouge	1,851.84	120·0
Haricot Emile nain sans parchemin	601.84	39.0
Haricot flageolet beurre nain	804.00	52.1
Haricot flageolet chevrier a grain toujours vert	407.40	26.4
Haricot flageolet jaune	686.26	44.6
Haricot intestin	450.60	29.2
Haricot ivoire sans parchemin	725.30	47.0
Haricot de Liancourt	817.89	53.0
Haricot de Lima	2,311.70	149.8
Haricot de Prague marbre	751.53	48.7
Haricot Princesse a rames	302.46	19 6
Haricot rouge de Chartres	500.00	32.4
Haricot rouge d'Orleans	614.18	39.8
Haricot du Saint Esprit	702.15	45.5
Haricot saumon du Mexique	694.44	45.0
Haricot de Sieva	618.82	40.1
Haricot de Soissons blanc	1,271.59	82.4
Haricot de Soissons nain	682.08	44.2
Haricot Suisse rouge	746.90	48.4
Haricot Turc	722.21	46.8
Hundred for One	374.4	24.26
Long White Cranberry	825.3	53.5
Mexican or California Prolific Tree	296.3	19.2
Mexican Tree	309.7	20.0
McMillon's Prolific	713·7	46.25
Ne Plus Ultra	566 3	36.7
Osborne's Early Forcing	548.6	35.55
Osborne's Forcing	490.6	31.79
Painted Lady	1,913.5	124·0
Painted Lady	1,377.0	89.23
Princess Rose	354.5	22.97
Princess Round White	386.6	25.05
Purple Speckled	932.1	60.44
Red Valentine	535.5	34.7

	Weight per 100 seeds. Grains.	Grammes.
Round-seeded Canary	486.3	31.5
Searles Carter's Champion	1,655.4	107.27
Sion House	688.	44.58
Southern Prolific	378.8	24.55
Venezuela, seed from (No. 5)	662.0	42.9
Venezuela, seed from (No. 6)	302.6	19.6
Venezuela, seed from (No. 7)	455.2	29.5
Venezuela, seed from (No. 9)	592.6	38.4
Very-long-podded Sugar	651.5	42.22
White Medium	346.9	22.48
White Round Wax	415.9	26.95
White Valentine	546.6	35.4
Yellow-podded Princess	384.1	24.89
Yellow-podded Princess	354.9	23.0
Yellow-podded White-seeded Sugar	554.8	35.95
Yellow Six-weeks round	588.3	38.12

Bean, Lima.

Bliss Early	1,550.9	100.5
Dreer's Improved	1,475.0	95.6
Large White	1,275.1	82.6
New Challenge	1,588.7	102.9
Potato	1,697.5	110.0
Red	1,228.4	79.6
Speckled	1,715.3	111.15

Beet.

Bastian's Early Blood Turnip	28.54	1.85
Bastian's Half-long Blood	37.80	2.45
Crapandine	28.85	1.87
Dark Red Egyptian	19.28	1.25
Dell's Flower Garden	30.87	2.005
Dewing's Extra Early Turnip	25.37	1.645
Dewing's Improved Blood Turnip	36.17	2.345
Dewing's Improved Blood Turnip (annual seed)	5.55	.36
Early Bassano	30.70	1.99
Early Blood Turnip	30.40	1.97
Early Egyptian	18.51	1.20
Early Yellow Turnip	21.75	1.41
Eclipse	15.27	.99
Extra Long Dark Blood	39.34	2.55
Erfurt Black Red	46.85	3.035
Hatch's Blood Turnip	27.31	1.77
Henderson's Dwarf Pine Apple	24.38	1.58
Improved Early Blood Turnip	35.34	2.29
Long Dark Blood	29.62	1.92
Simon's Early	32.25	2.09

Beet, Chard.

	Weight per 100 seeds. Grains.	Grammes.
Swiss Chard	35·33	2·29
White Swiss	28·85	1·872
Yellow Swiss	31·27	2·02

Beet, Mangold.

Henderson's Colossal Long Red	27·00	1·74
Long Red	28·54	1·85
Long Yellow	18·82	1·22
Mammoth Long Red	29·08	1·885
Norbiton's Giant	25·30	1·64
Orange Globe	29·62	1·92
Red Ovoid	37·80	2.45
Yellow Ovoid	29·16	1·89

Beet, Sugar.

Lane's Improved White	39·50	2·56
White French	33·94	2·20
White Imperial	35·33	2·29
Yellow French	32·40	2·10

Borage.

Borage	21·91	1·42

Broccoli.

Cabbage	4·93	·32
Carter's Summer	6·12	·397
Early Purple Cape	4·54	·292
" (another sample)	4·55	·295

Brussels Sprouts.

Imported	3·73	2·42
Rosemary	4·39	2·85

Burdock.

Gobo from Japan	17·90	1·16

Burnet.

Burnet	12·50	·81

Cabbage, Red.

Earliest Blood Red Erfurt	6·48	·42
Fine Red Dutch pickling	6·48	·42
Red Cabbage for pickling	5·86	·38
Red Drumhead	5·86	·38

Cabbage, Savoy.

Early Drumhead	4·78	·31
Early Dwarf	4·39	·285

	Weight per 100 seeds. Grains.	Grammes.
Early Green Curled	5·01	·325
Improved American	5·40	·35
Netted	4·63	·30
Ulm	4·93	·32
Very Early Paris	6·17	·40
Victoria	5·31	·345

Cabbage, White.

Broad Leaf from Japan	3·85	·25
Cannon Ball	5·86	·38
Early American Jersey Wakefield	5·71	·37
Early Bleichfield Giant	5·63	·30
Early Drumhead	5·09	·33
Early Dwarf Flat Dutch	5·09	·33
Early Dwarf York	6·63	·43
Early Etampes	5·40	·35
Early Jersey Wakefield	6·40	·415
Early Rainham	6·40	·415
Early Sugar Loaf	5·55	·36
Early Wyman	4·93	·32
Early York	6·17	·40
Excelsior	6·01	·39
Filderkraut	5·40	·35
Fottler's Brunswick Drumhead	4·78	·31
Fottler's Improved Early Brunswick	5·71	·37
Henderson's Early Summer	6·48	·42
Large Early York	4.93	·32
Large Late Bergen	6·01	·39
Large Late Drumhead	5·40	·35
Late Flat Dutch (Henderson's Selected)	6·32	·41
Late Round Winter, from Norway	9·56	·62
Mammoth Marblehead	5·40	·35
Nonpareil Early	5·71	·37
Quintal Drumhead	5·78	·375
Schweinfurt	4·85	·315
Schweinfurt, Largest White	4·93	·32
Schweinfurt Quintal	6·17	·40
Silverleaf Drumhead	5·71	·37
St. John's Day	6·48	·42
St. John's Day Early	5·94	·385
Stone Mason Marblehead	4·70	·305
Strassburg Quintal	4·78	·31
Tourlaville	5·71	·37
Vilmorin's Early Flat Dutch	5·24	·34
Wheeler's Cocoanut	5·09	·33
White Cabbage (Shira Na) from Japan	3·92	·255

Caraway.

Caraway	3·55	·23

Carrot.

	Weight per 100 seeds. Grains.	Grammes.
Altringham Long Red....	2·00	·13
Danvers	2·31	·15
Danvers	2·00	·13
Early French Scarlet Forcing	1·85	·12
Early Scarlet Short-horn.....................	1·85	·12
Garlies Red Horn...........................	2·00	·13
Half-long Luc..............................	1·54	·10
Half-long from annual plant	3·38	·22
Half-long from annual plant	3·55	·23
Half-long Stump-rooted..	1·85	·12
Half-long Red-pointed.......................	1·38	·09
Half-long Scarlet Carenton..................	1·54	·10
Half-long Scarlet Nantes...........	1·69	·11
Improved Long Orange........................	1·54	·10
James' Intermediate...........	1·54	·10
Large White Belgian.........................	1·69	·11
Large Yellow Belgian	1·85	·12
Long Orange.................................	2·31	·15
Long Red Surrey	1·85	·12
Minzin, from Japan..........................	2·16	.14
Norway, carrot from	1·69	·11
Transparent White...........................	2·31	·15
Violet or Purple	1·69	·11
Wild Carrot, from Geneva	1·32	·086
Wild Carrot, from Geneva	1·85	·12

Cauliflower.

Algiers	4·16	·27
Algerian Late	3·70	·24
Autumnal Late Giant	4·16	·27
Berlin Dwarf..................................	6·94	·45
Carter's Defiance Extra Early Forcing..........	4·16	·27
Carter's Dwarf Mammoth.......................	4·16	·27
Earliest Dwarf Erfurt	4·47	·29
Early Dutch............	4·78	·31
Early London	4·54	·295
Erfurt Early Dwarf............................	4·23	·275
Extra Early Paris	4·93	·32
Extra Early Paris (another sample)............	4·01	·26
Gerry Island..................................	4·01	·26
Imperial	4·53	·295
Italian Giant White...........................	4·40	·285
Large Late London	4·63	·30
Large White French, half early...............	3·85	·25
Le Normand's Short Stem	4·01	·26
Rice's Giant Snowball..................	5·20	·377
Snowball	5·40	·35
Stadtholders	6·01	·39
Thorburn's Wonderful.........................	4·01	·26
Veitch's Autumn Giant........................	4.32	·28
Walcheren	4·63	·30

Celery.

	Weight per 100 seeds. Grains.	Grammes.
Boston Market	.836	.0542
Boston Market (another sample)	.546	.0354
Carter's Crimson	.793	.0514
Carter's New Dwarf Crimson	.771	.05
Crawford's Half Dwarf White	.408	.0265
Dwarf Crimson	.481	.0312
Giant White Solid	.613	.0398
Golden Dwarf	.675	.0438
Golden Heart, half dwarf	.561	.0364
Half Dwarf	.533	.0346
Laing's Mammoth Red	.688	.0446
La Plume Chestnut	.572	.0374
Major Clarke's Pink	.626	.0406
Perfection Heartwell	.394	.0256
Sandringham Dwarf White	.69	.045
Sandringham Dwarf White (another sample)	.675	.0438
Seymour's Solid White	.69	.045
Seymour's Solid White (another sample)	.660	.0428
Seymour's Solid Red	.762	.0494
Sutton's Sulham Prize	.377	.0374
Turner's Dwarf White	.706	.0458
White Walnut	.546	.0354
Celeriac.		
Celeriac	.709	.0460
Apple Celeriac	.666	.0432
Chervil.		
Tuberous-rooted	3.39	.22
Chinese Cabbage.		
Pak Choi	3.39	.22
Pe Tsai	3.08	.20
Collards.		
True Southern	4.78	.31
Coriander.		
Coriander	12.80	.83
Cress.		
Plain-leaved	3.46	.225
Double Curled	3.08	.20
Broad-leaved Garden	2.69	.175
Cucumber.		
Boston Pickling	35.79	2.32
Early Cluster	38.11	2.47
Early Frame	42.58	2.76

	Weight per 100 seeds. Grains.	Grammes.
Early Green Prolific	42.89	2.78
Early Short Green	44.28	2.87
Early Russian	40.27	2.61
Extra Long Green Smooth	36.57	2.37
Extra Long White Spined	46.39	3.00
Gherkin	9.56	.62
Giant of Armstadt	51.53	3.34
Improved Long Green	38.11	2.47
Improved White Spine	42.43	2.75
Long Green	41.50	2.69
Marquis of Lorne	54.00	3.50
New Jersey Hybrid	34.71	2.25
Perfection Pickling	40.12	2.60
Russian Netted	35.02	2.27
Tailby's Hybrid	46.44	3.01
White German	41.50	2.69
White Spine	37.49	2.43
Cumin.		
Cuminum cyminum	5.86	.38
Dill.		
Dill	2.31	.15
Egg-plant.		
Black Pekin	5.71	.37
Black Pekin	3.98	.258
Early Long Purple	7.09	.46
Early Long Purple	7.03	.455
Extra Early Dwarf Purple	6.63	.43
Guadeloupe Striped	6.48	.42
Improved Large Purple	6.48	.42
Long White China	5.71	.37
Long Purple	5.71	.37
New York Improved	3.08	.20
Round Purple	5.40	.35
Round White	5.55	.36
Scarlet Chinese	5.40	.35
Scarlet-fruited	5.40	.35
Tomato-formed Red	5.55	.36
Tomato-formed Red	4.16	.27
White	6.32	.41
White Long Chinese	6.56	.445
Yellow (A Station Sport)	4.16	.27
Endive.		
Batavian	2.38	.155
Green Curled	2.46	.16
Moss Curled	2.50	.162

	Weight per 100 seeds. Grains.	Grammes.
Evening Primrose.		
Onagre, from France	1.08	.07
Fennel.		
Fennel, Sweet	7.71	.50
Gourd.		
Angora, Black Seeded	245.53	15·91
Massue d'Hercule	252.77	16.38
Massue tres longue	291.96	18.92
Melon de Malabar	263.57	17.08
Pelerine	198.60	12.87
Pelerine tres grosse	285.48	18.50
Plate de corse	202.77	13.14
Poire a poudre	194.90	12.63
Siphon	216.04	14.00
Grape.		
Niagara	59.50	3.843
Gumbo.		
Louisiana gumbo	86.42	5.60
Horehound.		
Horehound	1.38	.09
Hyssop.		
Hyssop	1.69	.11
Kohl-Rabi.		
Early Purple Vienna	5.86	.38
Early Smooth Purple	5.55	.36
Large White or Green	4.63	.30
Lavender.		
Lavender	1.69	.11
Leek.		
London Flag	5.24	.34
Musselburg	3.70	.24
Lettuce.		
American Gathering	2.47	.16
All the Year Round	2.07	.135
All the Year Round	2.16	.14
All the Year Round	2.04	1.36
Bath Cos	1.85	.12
Black-seeded Simpson	2.62	.17
Bossin	1.38	.09

	Weight per 100 seeds. Grains.	Grammes.
Boston Curled	1.54	.10
Boston Curled	1.46	.095
Boston Curled	1.32	.085
Brown Dutch	2.00	.13
Brown Dutch	1.66	.107
Brown Genoa Cabbage	1.85	.12
California Gardeners	1.69	.11
Crisp German Cabbage	1.54	.10
Curled Simpson	2.07	.135
Curled Simpson	2.01	.13
Deer Tongue	2.07	.135
Early Curled Silesian	1.54	.10
Early White Head	1.69	.11
Emperor Frame	1.69	.11
Ferry's Early Prize Head	2.16	.14
Frankford Head	2.00	.13
French Imperial Head	1.69	.11
Giant White Cos	1.54	.10
Golden Stone Head	2.16	.14
Gray-seeded Butter	2.00	.13
Green Cos	2.00	.13
Green Fat Cabbage	1.39	.09
Green Fringed	1.61	.105
Hammersmith Hardy Green	1.54	.10
Hanson	2.16	.14
Hanson	2.20	.142
Hardy Green Winter	1.61	.105
Ice Drumhead	1.76	.115
Ice Drumhead	1.80	.116
Improved Spotted Cabbaging	1.38	.09
India Head	2.38	.155
Large Princess Head	1.85	.12
Large White Stone Summer	2.31	.15
Large Yellow Butter	1.38	.09
Malta Large Drumhead	2.00	.13
Marvel or Red Beson	1.54	.10
Marvel or Red Beson	1.54	.10
Neapolitan Cabbage	1.85	.12
New Orleans Green Cabbage	1.54	.10
New Orleans Green Cabbage	1.51	.098
Paris White Cos	1.38	.09
Perpetual	2.47	.16
Perpignan	1.69	.11
Philadelphia Butter	1.85	.12
Prize Head	2.62	.17
Salamander	1.69	.11
Satisfaction Black Seeded	2.16	.14
Satisfaction White Seeded	1.85	.12
Shotwell Brown Head	2.47	.16
Sugar Loaf	2.47	.16

	Weight per 100 seeds. Grains.	Grammes.
Tennis Ball	1.54	.10
Tennis Ball	1.85	.12
The Deacon	1.85	.12
Versailles Cabbage	2.00	.13
Victoria Cabbage	2.31	.15
Wheeler's Tom Thumb	1.38	.09
White Batavian	1.38	.09
White Cabbage	1.38	.09
White Cabbage	1.49	.09
White Chavigny	1.54	.106
White Cos	1.23	.08
White Cos	1.24	.08
White Forcing Head	1.38	.09
White Tennis Ball	1.85	.12
Yellow-seeded Butter	1.69	.11
Maize, Sweet.		
Amber Cream	250.76	16.25
Black Mexican	282.40	18.30
Black Sugar	210.95	20.15
Crosby's Early	331.78	21.50
Darling's Early	334.10	21.65
Dolly Dutton	291.65	18.9
Early eight-rowed	429.00	27.80
Early Marblehead	333.63	21.62
Early Minnesota	318.67	20.65
Early Narragansett	352.61	22.85
Early Orange	373.44	24.20
Egyptian	385.80	25.00
Excelsior Early	263.12	17.05
Extra Early Dwarf Sugar	334.10	21.65
Golden Sweet	442.12	28.65
Hickox Improved	350.30	22.70
Mammoth	334.87	21.70
Moore's Early Concord	312.49	20.25
Ne Plus Ultra	187.49	12.15
New Triumph	362.64	23.50
Pratt's Early	361.87	23.45
Rochester	320.21	20.75
Squantum Sugar	344.13	22.30
Stowell's Evergreen	287.03	18.60
Stowell's Evergreen (another sample)	277.00	17.95
Sweet Asylum	341.81	22
Tom Thumb	383.47	24.15
Wyoming Sugar	382.70	24.85 .80
Maize, garden varieties not sweet.		
Adam's Early	436.72	28.30
Forty days	391.20	25.35
Tuscarora	695.98	45.10

Maize, ornamental varieties.

	Weight per 100 seeds. Grains.	Grammes.
Japanese Striped	149.68	9.70
Miniature	67.89	4.40

Maize, field varieties, flint.

Early Dutton, selected ear	437.49	28.35
Early eight-rowed Brown, selected ear	712.95	46.20
Improved King Philip	461.87	29.93
New England twelve-rowed, selected ear	561.10	36.36
Red Glazed, eight-rowed	444.12	28·78
Rural Thoroughbred, selected ear	729.93	47.30
Waushakum	577.11	37.43
Venezuela, White from	592.58	38.40
Venezuela, Yellow from	371.90	24.10

Maize, pop corn.

Golden Pop	114.96	7·45
New England Pop	171.91	11.14

Maize, field varieties, Dent.

Benton Dent, selected ear	1,058.60	68.6
Benton Dent	1,048·65	67.96
Bessarabia	613.41	39.75
Chester County Mammoth	435.17	28.20
Indian Mound, grown from seed taken from a (?)	616.50	39.95
Indian Mound, grown from seed taken from a (?)	651.38	42.21
Little Red Cob	490.89	31.81
Sibley's Pride of the North	416.66	27.00
Sibley's Pride of the North (anothersample)	388.88	25.20

Marjoram.

Sweet Marjoram	.32	.021

Martynia.

Martynia Proboscidea	61.00	3.96
Martynia Proboscidea	70.37	4.56
Martynia Craniolaria	60.64	3.93

Melon.

Algiers Cantaloupe	36.87	2.39
Allen's Superb	38.88	2.52
Bay View	45.36	2.94
Black Portugal	45.57	2.96
Boston, Large Nutmeg	43.51	2.82
Boston Pet	43.51	2.82
Burpee's Netted Gem	40.58	2 63
California Nectar	48.76	3.16
Casaba	42.58	2.76
Casaba (another sample)	44.59	2.89

	Weight per 100 seeds. Grains.	Grammes.
Chicago Nutmeg	45.36	2.94
Christiana (Station seed)	49.00	3.17
Christiana, Improved	38.11	2.47
Christiana (another sample)	40.73	2.64
Early White Japan	44.28	2.87
Green Nutmeg	41.04	2.66
Green Nutmeg, Improved	51.38	3.33
Hackensack	44.44	2.88
Hackensack (another sample)	51.69	3.35
Hardy Ridge	56.47	3.66
Jenny Lind	41.04	2.66
Log of Wood	52.30	3.39
Long Persian (Casaba)	45.57	2.96
Long Yellow	40.27	2.61
Montreal Market	42.58	2.76
New Surprise	43.97	2.85
New Surprise (another sample)	41.97	2.72
Pine Apple	40.89	2.65
Pomegranate	15.27	.99
Prolific Nutmeg	40.89	2.65
Round Yellow Cantaloupe	45.57	2.96
Shaw's Golden Superb	44.74	2.90
Sill's Hybrid	41.04	2.66
Skillman's Fine Netted	41.04	2.66
Surprise	44.59	2.89
True Valparaiso	41.66	2.70
Valentia	56.01	3.63
Venezuela, seed from	66.35	4.30
Ward's Nectar	40.27	2.61
White Japanese	45.36	2.94
Mustard.		
White	5.71	.37
White Chinese	8.02	.52
Black	3.39	.22
Nightshade.		
Morelle d'Isle de France	1.85	.12
New Zealand Spinage.		
New Zealand Spinage	132.55	8.59
Okra.		
Dwarf	80.55	5.22
Dwarf Green	37.10	2.41
Tall	83.64	5.42
Onion.		
Brown Teneriffe	6.17	.40
Danver's Yellow Globe, crop of 1881	5.24	.34

	Weight per 100 seeds. Grains.	Grammes.
Danver's Yellow Globe, crop of 1882	6.32	.41
Early Red Globe	4.78	.31
Early White Naples	4.93	.32
Early Yellow Cracker	6.17	.40
El Paso	5.55	.36
Extra Early No. 1 (Wells), crop 1882	6.48	.42
Extra Early Red	4.78	.31
Extra Early Red (Wells), crop 1882	5.86	.38
Flat Madeira	6.48	.42
Giant Rocca of Naples	5.40	.35
Globe Madeira	6.17	.40
Golden Queen	5.24	.34
Large Red Italian Tripoli	4.32	.28
Large Red Wethersfield	5.40	.35
Large Red Wethersfield (another sample)	4.63	.30
Large Red Wethersfield, crop of 1881	6.17	.40
Large Red Wethersfield, crop of 1882 (Wells)	6.48	.42
Large Strasbourg	5.55	.36
Large White Flat Italian Tripoli	5.24	.34
Large Yellow	4.63	.30
Large Yellow Dutch	6.17	.40
New Neapolitan Marzagole	5.09	.33
New Queen	5.09	.33
New Queen (another sample)	5.24	.34
Nocera	4.01	.26
Pale Red Etna	6.01	.39
Philadelphia White	4.01	.26
Red Bassano of Genoa	4.16	.27
Red Genoa	4.63	.30
Red Globe	6.17	.40
Silver White Etna	5.55	.36
Welsh	4.93	.32
White Calabria	5.86	.38
White Globe	5.86	.38
White Globe	4.99	.325
White Lisbon	5.09	.33
White Portugal	5.24	.34
White Portugal, crop of 1882 (Wells)	4.93	.32
White Silverskin	3.70	.24
White Silverskin, crop of 1881	5.09	.33
Yellow Danvers	4.16	.27
Yellow Danvers, crop of 1882 (Wells)	6.17	.40
Yellow Globe	6.32	.41
Orach.		
Red Orach	3.55	.23
White Orach	7.09	.46
Parsley.		
Carter's New Fern-leaf	2.62	.17
Champion Moss Curled	3.24	.21

	Weight per 100 seeds. Grains.	Grammes.
Double Curled	2.54	.165
Hamburg	2.03	.132
Moss Curled	2.62	.17
Norway, from	2.00	.13
Triple Curled	2.47	.16
Parsnip.		
Abbott's Hollow Crown	7.71	.50
Carter's New Maltese	5.40	.35
Early Round or Turnip	4.47	.29
Guernsey or Cup	4.93	.32
Long White Dutch		
Sutton's Student	6.48	.42
Turnip Rooted	5.40	.35
Wild, from Geneva	7.22	.47
Wild, from Geneva	6.94	.45
Pea, Station crop marked *.		
American Wonder*	415.1	26.9
American Wonder*	419.7	27.2
Bishop's Dwarf Prolific*	399.6	25.9
Bishop's Long Pod*	617.7	40.0
Bishop's Long Pod*	594.1	38.5
Bishop's Long Pod*	373.4	24.2
Black Eyed Marrowfat*	617.2	40.0
Black Eyed Marrowfat*	606.4	39.3
Blue Imperial*	634.2	41.1
Blue Imperial*	620.3	40.2
Blue Imperial Dwarf	484.5	31.4
Blue Peter	473.7	30.7
British Queen*	637.3	41.3
British Queen*	614.2	39.8
Brown's New Dwarf Early Marrowfat	455.2	29.5
Carter's Challenger	507.7	32.9
Carter's First Crop	328.7	21.3
Champion of England*	435.3	28.28
Champion of England*	429.0	27.8
Commander in Chief (Carter's)	285.48	18.5
Culverwell's Telegraph*	578.7	37.5
Culverwell's Telegraph*	541.6	35.1
Daniel O'Rourke*	428.2	27.75
Daniel O'Rourke*	427.4	27.7
Day's Early Sunrise*	594.9	38.5
Day's Early Sunrise*	584.8	37.9
Dr. McLean	351.8	22.8
Dwarf Champion	277.7	18.0
Eugenia*	520.0	33.7
Eugenia*	526.2	34.1
Extra Early Alpha	412.0	26.7
Extra Early Alpha*	429.0	27.8
Extra Early Kent	311.7	20.2

	Weight per 100 seeds. Grains.	Grammes.
Ferry's Extra Early	334.8	21.7
Fill Basket	405.8	26.3
First and Best, Cleveland's	296.3	19.2
First and Best, Ferry's	322.5	20.9
First and Best, Sibley's	317.9	20.6
First and Best, Thorburn's	387.3	25.1
Hair's Dwarf Green Marrow*	597.2	38.70
Hair's Dwarf Green Marrow*	627.3	40.65
Hancock	337.9	21.9
Henderson's First of All	331.8	21.5
Horsford's Market Garden	300.9	19.5
Japan "Bari," Chick Peas	535.4	34.7
Japan "Narosis," Chick Peas	620.3	40.2
Japan Volo	483.0	31.3
John Bull	532.4	34.5
Kentish Invicta *	394.2	25.5
Kentish Invicta *	412.0	26.7
Large White Marrowfat	533.9	34.6
Laxton's Earliest of All *	335.6	21.75
Laxton's Earliest of All *	337.9	21.9
Laxton's Long Pod *	410.4	26.6
Laxton's Long Pod *	412.8	26.75
Laxton's Marvel *	563.2	36.5
Laxton's Marvel *	527.7	34.2
Laxton's Omega	412.0	26.7
Laxton's Supreme	430.5	27.9
Little Wonder, Carter's	496.9	32.2
McLean's Advancer *	388.8	25.2
McLean's Advancer *	384.2	24.9
McLean's Blue Peter *	479.4	31.07
McLean's Little Gem *	469.1	30.4
McLean's Little Gem *	421.3	27.3
McLean's Premier	413.5	26.8
Minimum	264.6	17.15
Napoleon *	399.8	25.9
Napoleon *	385.8	25.0
Philadelphia Extra Early *	378.0	24.5
Philadelphia Extra Early *	421.3	27.3
Premium Gem *	427.4	27.7
Premium Gem *	436.7	28.3
Premium Gem, Carter's	375.3	24.3
Pride of the Market, Carter's	451.4	29.25
Prize-taker Green Marrow	356.5	23.1
Racket	280.8	18.2
Royal Dwarf Marrowfat	550.9	35.7
Strategem	467.6	30.3
Strategem	519.4	33.6
Telephone	452.1	29.3
Telephone, Carter's	464.5	30.1
Thorburn's First and Best *	405.4	26.2
Tom Thumb *	313.2	20.3

	Weight per 100 seeds. Grains.	Grammes.
Tom Thumb*	330.2	21.4
Veitch's Perfection	365.7	23.7
Waite's Caractacus	316.3	20.5
White Marrowfat*	631.1	40.9
White Marrowfat	611.8	39.65
William the First*	447.5	29.0
William the First*	424.4	27.5
William the First*	427.5	27.7
Yorkshire Hero	513.9	33.3

Pea, Sugar.

Dwarf Gray Sugar*	365.7	23.7
Dwarf Gray Sugar*	364.2	23.6
Dwarf Gray Sugar*	239.2	15.5
Dwarf White Sugar	256.17	16.16
Tall Gray Sugar*	486.1	31.5
Tall Gray Sugar*	458.32	29.7
Tall Sugar*	446.7	28.95
Tall Sugar*	439.8	28.5
Wrinkled Sugar*	416.6	27.0
Wrinkled Sugar*	407.4	26.4

Peppers.

Cayenne, True	7.87	.51
Cherry, Red	7.87	.51
Cherry, Red	7.64	.495
Giant Emperor	10.95	.71
Giant Emperor (another sample)	11.33	.735
Large Bell or Bull Nose	11.45	.744
Large Bell or Bull Nose	11.36	.736
Large Squash	11.11	.72
Long Red	7.71	.50
Long Red Cayenne	8.48	.55
Long Red Cayenne	9.02	.584
Long Yellow	10.64	.69
Long Yellow Cayenne	9.72	.63
Long Yellow Cayenne	10.39	.674
Monstrum	11.11	.72
New Cranberry	5.53	.36
New Cranberry	5.09	.33
New Oxheart	10.95	.71
Orange Bell	9.09	.59
Oxheart	8.64	.56
Piment Violet	8.17	.53
Small Red Chili	5.40	.35
Small Red Chili	5.07	.33
Spanish Monstrous	10.03	.65
Squash or Tomato-shaped	10.80	.70
Squash or Tomato-shaped	10.74	.696
Sweet Golden Dawn	9.56	.62

	Weight per 100 seeds. Grains.	Grammes.
Sweet Mountain or Mammoth	12.50	.81
Sweet Mountain or Mammoth	11.95	.71
Sweet Spanish	8.95	.58

Pumpkin.

Cashew	200.92	13.02
Connecticut Field	247.22	16.02
Large Cheese	139.66	9.05
Mammoth	525.30	17.02
Sucrier du Bresil	199.68	12.94

Radish.

Black Spanish Long	13.58	.88
Black Spanish Round	12.03	.78
California Mammoth Winter	16.66	1.08
California Mammoth Winter	17.79	1.154
Chinese Rose Winter	13.73	.89
Chinese White Winter	16.66	1.08
Chinese White Winter	18.06	1.17
"Daikon" from Japan	18.51	1.20
Early Long Scarlet	18.51	1.20
Early Long Scarlet Short-tip	18.36	1.19
Early Scarlet Turnip-rooted	13.58	.88
Early Scarlet or Red Turnip	15.27	.99
Early Yellow Turnip	14.19	.92
Ferry's Perpetual Market	18.36	1.19
French Breakfast White-tipped	16.20	1.05
Golden Globe	16.05	1.04
Long White Naples	14.71	.96
Long White Russian	18.05	1.17
Olive Gray	16.05	1.04
Olive Rose	13.42	.87
Olive Scarlet	13.88	.90
Olive White	12.65	.82
Turnip-rooted	16.20	1.05
Turnip-rooted	15.51	1.005
White Spanish	13.42	.87
White Turnip	10.34	.67
Wood's New Frame	15.74	1.02

Rape.

Rape	2.62	.17

Roquette.

Roquette	2.47	.16

Rosemary.

Rosemary	1.54	.10

Rue.

	Weight per 100 seeds. Grains.	Grammes.
Ruta graveolens	3.08	.20

Saffron.

Saffron	54.93	3.56

Sage.

Sage	10.18	.66

Salsify.

Blue Flowered French	14.63	.945
Annual plant of Salsify	19.48	1.26
Annual plant of Salsify	19.28	1.25

Savory.

Summer Savory	.92	.06

Savoys.

Dalmeny Sprouts	5.55	.36
Feather Stem	5.24	.34
Tom Thumb	4.16	.27

Scolymus.

Scolymus hispanicus	3.62	.235

Scorzonera.

Scorzonera	17.74	1.15
Scorzonera, annual plant	10.16	.66
Scorzonera	19.75	1.28

Scurvy Grass.

Scurvy Grass	.926	.06

Sea Kale.

Beck's Improved	33.80	2.19

Shallot.

Shallot	5.16	.335

Skirret.

Skirret	1.76	.115

Snails.

Snails	404.62	26.22

Sooly Qua.

Sooly Qua	191.35	12.40

Sorghum.

	Weight per 100 seeds. Grains.	Grammes.
African	27.48	1.78
African Wheat	16.51	1.07
Amber Sugar Cane	27.93	1.81
Bear Tail	29.34	1.90
Brown Dourha	42.74	2.77
Chinese Sugar Cane	37.06	2.40
Dhoura	55.89	3.62
Early Amber	26.25	1.70
Egyptian Rice	46.59	3.02
Goose Neck	29.10	1.88
Gray Top	32.12	2.08
Honduras	21.92	1.42
Honey	29.03	1.88
Iowa Red Top	25.48	1.65
Liberian	26.25	1.70
Link's Hybrid	28.26	1.83
Miller	29.49	1.91
Neeazana	30.57	1.98
Regular	29.64	1.92
Stump	32.12	2.08
White Mammoth	29.80	1.93

Spinage.

Bloomsdale	13.58	.88
Horenso, from Japan	11.57	.75
Long Standing	9.87	.64
Prickly or Fall	25.00	1.62
Prickly or Fall	20.61	1.336
Round or Summer	15.43	1.00
Round or Summer	14.26	.925
Savoy leaf	18.51	1.20
Thick-leaved Round	12.41	.805
Viroflay	14.71	.96

Squash.

Boston Marrow	307.08	19.90
Butman	325.61	21.10
Custard Marrow	76.38	4.95
Early White Bush Scollop	124.68	8.08
Early Yellow Bush Scollop	164.96	10.69
Essex Hybrid	298.60	19.35
Essex Hybrid (another sample)	205.24	13.30
Golden Crookneck, Summer	114.81	7.44
Green Striped Bush	125.45	8.13
Hubbard	329.62	21.36
Low's Premium Turban	336.41	21.80
Mammoth	762.17	49.39
Marblehead	364.19	23.60
Perfect Gem	86.88	5.63

	Weight per 100 seeds. Grains.	Grammes.
Turban	331.63	21.49
Turban (another sample)	343.66	22.27
Vegetable Marrow	180.55	11.7
Venezuela, seed from	91.66	5.94
Yokohama	145.82	9.44

Sunflower.

Dwarf Double	38.11	2.405

Sweet Basil.

Sweet Basil	2.00	.13

Thyme.

Broad-leaved English	.43	.028

Tomato.

Alpha	3.70	.24
Acme	5.86	.38
Acme	4.45	.29
Arlington	4.78	.31
Blount's Champion Cluster	4.85	.315
Boston Market	4.63	.30
Broad-leafed Dwarf	4.16	.27
Canada Victor	4.23	.275
Conqueror	4.78	.31
Cook's Favorite	3.70	.24
Criterion	4.63	.30
Currant, New	1.46	.095
Early Conqueror	5.24	.34
Early Red Smooth	4.93	.32
Early Round Red Smooth	4.70	.305
Early York	4.01	.26
Essex Early Hybrid	5.86	.38
Extra Early Red, Sibley's	4.47	.29
Feejee Island Red	4.01	.26
General Grant	3.85	.25
Green Gage	4.32	.28
Green Gage	4.01	.26
Great Chihuahua	5.09	.33
Golden Trophy	3.85	.25
Hathaway's Excelsior	4.16	.27
Howard	4.01	.26
Hubbard Curled Leaf	3.55	.23
Hundred Day	4.47	.29
Improved Large Yellow	3.24	.21
Keyes' Early Prolific	3.70	.24
Large Red	4.32	.28
Large Red Smooth Round	4.70	.305
Little Gem	3.85	.25

	Weight per 100 seeds. Grains.	Grammes.
Livingstone's Favorite	5.45	.353
Livingstone's Favorite	5.60	.363
Livingston's Perfection	4.32	.28
Lyman's Mammoth Cluster	4.70	.305
Mayflower	4.39	.285
Mayflower	5.71	.37
New French Upright	4.54	.295
New Japanese	4.01	.26
New White Apple	4.16	.27
Orangefield	4.63	.30
Paragon	6.17	.40
Paragon	4.06	.265
Pear	3.70	.24
Powell's	3.85	.25
President Garfield	5.09	.33
Read's Island Beauty	5.47	.355
Red Cherry	1.85	.12
Red Chief	4.63	.30
Red Tomato from South America	3.85	.25
Red Valencia Cluster	4.47	.29
Rochester	4.32	.28
Tilden's New	4.78	.31
Triumph	4.92	.32
Triumph	4.70	.305
Trophy	7.40	.48
Trophy	7.28	.47
Trophy Extra Selected	4.78	.31
Turk's Cap	4.01	.26
Turk's Cap	3.84	.25
White from South America	4.09	.265
White from South America	3.81	.25
Yellow Cherry	2.00	.13
Yellow Fig	3.08	.20
Yellow Pear-shaped	3.39	.22
Yellow Pear-shaped	3.31	.215
Yellow Plum	3.55	.23
Yellow Victoria	4.47	.29

Turnip.

Amber Globe, Large	3.08	.20
Black Stone	3.55	.23
Carter's Stone or Stubble	3.24	.21
Carter's Imperial Purple Top	3.55	.23
Cow Horn	3.08	.20
Cow Horn Strap-leaf	2.93	.19
Early Long Red Tankard	3.24	.21
Early White Flat Dutch	2.77	.18
Early White Strap-leaved	2.77	.18
Early White Six-weeks	3.08	.20
Early White Strap-leaf	3.15	.205

	Weight per 100 seeds. Grains.	Grammes.
Early Yellow Stone	3.39	.22
German Teltow	2.31	.15
Gray Stone	3.24	.21
Golden Stone	2.77	.18
Green Barrel	3.08	.20
Green Globe	3.85	.26
Green Globe (another sample)	4.01	.26
Jersey Lily	2.93	.19
Jersey Navet	2.93	.19
Jersey Navet, True	2.39	.22
"Kabu" from Japan	4.16	.27
Large Yellow Scotch	3.55	.23
Long White Strap-leaf	2.93	.19
Long White Tankard	3.70	.24
Long White Vertus	3.24	.21
Montmagny	3.08	.20
New Yellow Finland	1.85	.12
Nimble Six-weeks	3.39	.22
Petrowski	1.54	.10
Petrowski (another sample)	1.54	.10
Pomeranian White Globe	3.70	.24
Purple-top Munich	3.39	.22
Purple-top Strap-leaf	3.85	.25
Purple-top White Globe	3.55	.23
Red-top Flat Norfolk	3.39	.22
Robson's Golden Ball	2.77	.18
Seven Top	2.62	.17
Sweet German	3.39	.22
White Egg	3.55	.23
White Flat or Globe	3.55	.23
White Flat Norfolk	4.01	.26
White Garden Stone	4.01	.26
Yellow Dutch	2.31	.15
Yellow Malta	2.16	.14

Turnip, Swedish.

American Ruta-baga	4.16	.27
Bangholm Swede	4.16	.27
Carter's Imperial Swede	4.16	.27
Carter's Imperial Purple-top Hardy Swede	4.47	.29
Curly-top Ruta-baga	4.01	.26
Ferry's Improved Purple Top Yellow Swede	5.24	.34
Hartley's Ruta-baga	4.63	.30
Improved Yellow Swedish Turnip	4.32	.28
Laing's Purple-top Swede	4.01	.26
London Swede	4.93	.32
Marshall's Extra Purple-top Swede	4.32	.28
Ruta-baga, from Norway	5.24	.34
Shamrock Ruta-baga	4.47	.29
Skirving's Purple-top Ruta-baga	4.63	.30

	Weight per 100 seeds. Grains.	Grammes.
Sutton's Improved Champion Swede	4.93	.32
White Swede or Russian	4.47	.29
White Sweet German Ruta-baga	4.32	.28
Watermelom.		
Apple Pie	267.27	17.32
Apple seeded	89.04	5.77
Black Italian	158.79	10.29
Black Spanish	163.88	10.62
Boss	172.99	11.21
California	120.82	7.83
Citron	222.67	14.43
Cuban Queen	150.45	9.75
Early Jersey	138.88	9.00
Early Mountain Sprout	140.88	9.13
Georgia Rattlesnake	172.68	11.19
Golden Fleshed	135.48	8.78
Goodwin's Imperial	78.39	5.08
Gypsey	153.85	9.97
Icing or Ice Rind	105.55	6.84
Long Hill	235.03	15.23
Long Island	180.55	11.70
Mountain Sprout	183.63	11.90
New Orange	137.80	8.93
New Round Excelsior	145.05	9.40
Odella	153.59	9.96
Peerless or Ice Cream	129.00	8.36
Peerless or Ice Cream (another sample)	123.45	8.00
Perfection	158.33	10.26
Phinney's Early	135.17	8.76
Scaly Bark	177.62	11.51
Sculptured Seeded Japan	142.58	9.24
Strawberry	118.36	7.67
Vick's Early	150.30	9.74
Weeds.		
Amarantus retroflexus	0.41	.027
Chenopodium album	0.91	.059
Whitloof.		
Brussels-rooted Chicory	2.31	.15
Worms.		
Worms	149.06	9.66

Relations of Feed to Milk.

Our experiments in cattle feeding, commencing January 2 and continuing until February 18, 1883, were intended as a study into the influence of the food of the cow upon butter production, and as also a special inquiry into the properties of ensilage as a feeding material.

The cows used for the experiment were unpedigreed Jerseys, four in number.

Emm, seven years old, dropped her last calf October 30, 1882, and not now in calf.

Ann, seven years old, dropped last calf last of April, 1882, and due to calve in April, 1883.

Meg, four years old, dropped her last calf December 4, 1883.

Jem, two and a half years old, dropped her last calf October 24, 1882.

The food preceding the experiment was four pounds wheat bran and four pounds corn meal per cow daily, together with hay *ad libitum.*

The normal weight of the cows may be calculated from the following data, the food being alike on the various intervals: From December 10–12, average weight, seven hundred and nine pounds per cow; December 20–22, seven hundred and ten pounds per cow; December 30 to January 1, seven hundred and five pounds per cow; January 5–7, seven hundred and nine pounds per cow; February 15–17, six hundred and eighty-five pounds per cow; February 25–27, seven hundred pounds per cow, or two thousand eight hundred and twelve pounds for the four cows. In like manner the normal milk yield calculated from the yield during these periods was 13.36 pounds.

During the continuation of the experiments the hay was fed dry, cut in about half inch lengths. The grain was given separately in equal portions morning and night. The water was weighed and each cow given, twice a day, what she would drink. Two ounces of salt per cow were given each Sunday morning. The waste food collected each day contained the hay only, except in the case of the gluten meal, which, being unpalatable to the cows, was only partially eaten.

The remarks concerning the condition of the individual cows during the experiment period and preceding are as below:

December 31. Emm seemed to be suffering from indigestion.

January 11. Ann refused part of her morning's bran, and no bran given her at night.

January 12. Meg refused part of her morning's bran, and no bran given her at night.

January 17. Emm and Jem refused part of their morning's gluten meal, and none given them at night.

January 18. All the cows sick of the gluten meal, yet eager for other food. They would hardly touch the gluten meal, even when sprinkled on hay.

January 19. Ann refused part of her morning's gluten meal.

January 22. Jem's bowels rather loose.

January 23. Emm seemed to suffer from the cold to-day, and ate but little of her morning's hay.

January 25. Emm shows signs of slight colic, and refused to eat.

January 29. Under hay, corn meal and ensilage Meg refused her morning's feed, and received no ensilage or meal at night.

The day's milk for the purposes of analysis and for churning was the mixed evening's and morning's milk. The milk was kept in deep cans in a cool place, and the churning was upon the fourth day, the milk previously having been set over night in a warm room. The whole milk was churned in a barrel churn, which rotated end over end. The butter, after being well worked, was then weighed, no salt being

added. As whatever changes of food were made were made in the morning after milking, the milk of the morning in reality must be credited to the food of the preceding day, as it is in our calculations which follow.

The data upon which our conclusions are to be based are represented in the following tables.

Food fed to the four cows.

DATE. 1883.	Hay. Lbs.	Corn meal. Lbs.	Shorts. Lbs.	Gluten meal. Lbs.	Ensilage. Lbs.	Total. Lbs.
January 2	80	16	16	..	...	112
" 3	80	16	16	..	...	112
" 4	80	16	16	..	...	112
" 5	80	16	16	..	...	112
" 6	80	16	16	..	...	112
" 7	80	16	16	..	...	112
" 8	80	..	48	..	...	128
" 9	80	..	48	..	...	128
" 10	80	..	48	..	...	128
" 11	60	..	42	..	...	102
" 12	60	..	42	..	...	102
" 13	60	..	48	..	...	108
" 14	60	..	48	..	...	108
" 15	60	..	16	16	...	92
" 16	60	..	..	48	...	108
" 17	60	..	..	36	...	96
" 18	60	..	..	48	...	108
" 19	60	..	..	48	...	108
" 20	60	40	..	..	...	100
" 21	60	40	..	..	...	100
" 22	60	40	..	..	...	100
" 23	60	40	..	..	...	100
" 24	60	40	..	..	...	100
" 25	60	40	..	..	...	100
" 26	20	16	16	..	40	92
" 27	20	16	16	..	40	92
" 28	20	16	16	..	40	92
" 29	20	14	..	..	75	109
" 30	20	16	..	..	80	116
" 31	20	16	..	..	80	116
February 1	..	16	..	..	120	136
" 2	..	16	..	..	120	136
" 3	..	16	..	..	120	136
" 4	..	..	..	..	160	160
" 5	..	..	..	..	180	180
" 6	..	..	..	..	220	220
" 7	..	..	..	..	240	240
" 8	..	..	..	..	250	250

Food fed to the four cows — (Continued).

DATE. 1883.	Hay. Lbs.	Corn meal. Lbs.	Shorts. Lbs.	Gluten meal. Lbs.	Ensilage. Lbs.	Total. Lbs.
February 9	..	..	..	..	255	255
" 10	..	..	..	..	235	235
" 11	..	..	..	..	235	235
" 12	80	16	16	..	...	112
" 13	60	16	16	..	...	92
" 14	60	16	16	..	...	92
" 15	60	16	16	..	...	92
" 16	60	16	16	..	..	92
" 17	60	16	16	..	...	92
" 18	60	16	16	..	...	92

Food consumed by the four cows, excrement and live weight.

DATE. 1883.	Total consumed. Food and water. Lbs.	Total dry substance. Lbs.	Water fed. Lbs.	Water drank. Lbs.	Total water. Lbs.	Excrement voided. Lbs.	Weight of cows. Lbs.
Jan. 2	333.44	89.03	15.53	228.88	244.41	205	2826
" 3	343.63	86.77	15.17	241.69	256.86	205	2792
" 4	400.38	85.37	14.94	300.06	315.00	218	2809
" 5	308.81	84.72	14.84	209.25	224.09	232	2856
" 6	355.25	86.88	15.18	253.19	268.37	228	2810
" 7	393.19	83.38	14.62	295.19	309.81	225	2828
" 8	358.06	95.09	15.53	247.44	262.97	244	2878
" 9	402.88	88.09	14.41	300.38	314.79	228	2871
" 10	350.06	70.49	11.57	268.00	279.57	237	2910
" 11	331.44	77.14	12.55	241.75	254.30	219	2918
" 12	295.25	77.19	12.56	205.50	218.06	214	2905
" 13	358.69	84.60	13.77	260.31	274.08	240	2873
" 14	397.81	85.09	13.85	298.87	312.72	250	2875
" 15	308.75	74.43	10.82	223.50	234.32	336	2898
" 16	298.63	91.16	11.03	196.44	207.47	194	2864
" 17	268.69	72.98	9.02	186.69	195.71	164	2830
" 18	371.44	79.32	9.12	283.00	292.12	176	2814
" 19	271.06	73.61	8.20	189.25	197.45	181	2860
" 20	344.25	70.85	14.21	259.19	273.40	170	2874
" 21	352.00	72.79	14.52	264.69	279.21	194	2872
" 22	232.50	70.85	14.21	147.44	161.65	199	2900
" 23	280.75	67.19	13.62	199.94	213.56	162	2819
" 24	259.25	68.11	13.76	177.37	191.13	182	2829
" 25	292.81	72.79	14.52	205.50	220.02	177	2815
" 26	194.31	49.80	39.26	105.25	144.51	178	2823

Food consumed by the four cows, excrement and live weight — (Continued).

DATE. 1883.	Total consumed. Food and water. Lbs.	Total dry substance. Lbs.	Water fed. Lbs.	Water drank. Lbs.	Total water. Lbs.	Excrement voided. Lbs.	Weight of cows. Lbs.
Jan. 27....	260.69	48.62	39.07	173.00	212.07	145	2757
" 28....	298.94	50.02	39.29	209.63	248.92	158	2783
" 29....	164.94	39.27	52.42	73.25	125.67	138	2821
" 30....	203.56	38.81	67.50	97.25	164.75	138	2745
" 31....	222.50	35.85	67.02	109.62	176.64	122	2725
Feb. 1....	219.69	38.29	96.77	84.63	181.40	132	2730
" 2 ...	161.94	38.47	97.53	25.94	123.47	121	2731
" 3....	176.63	38.47	97.53	40.63	138.16	103	2705
" 4....	187.13	34.17	125.83	27.13	152.96	108	2702
" 5....	199.44	38.47	141.53	19.44	160.97	102	2709
" 6....	230.44	47.01	172.99	10.44	183.43	108	2742
" 7....	233.81	50.01	183.80	......	183.80	122	2791
" 8....	256.56	51.74	190.20	14.62	204.82	146	2757
" 9....	246.94	51.74	189.95	5.25	195.20	150	2823
" 10....	224.56	48.03	176.53	......	176.53	172	2831
" 11....	235.56	48.29	178.15	9.12	187.27	164	2826
" 12....	210.88	84.99	14.63	111.25	125.88	175	2803
" 13....	311.56	66.05	11.57	233.94	245.57	198	2743
" 14....	292.63	67.88	11.87	212.88	224.75	207	2762
" 15....	240.44	71.06	12.38	157.00	169.38	186	2771
" 16....	365.44	70.20	12.24	283.00	295.24	185	2696
" 17....	298.94	72.02	12.54	214.38	226.92	194	2770

Consumed in Food.

DATE. 1883.	Albuminoids. Lbs.	Fat. Lbs.	Nitrogen — free extract. Lbs.	Crude fibre. Lbs.
January 3............	7.48	2.60	47.32	24.59
" 4............	7.39	2.57	56.66	24.04
" 5............	7.35	2.57	46.37	27.00
" 6............	7.49	2.68	47.38	24.64
" 7............	7.27	2.96	45.74	23.28
" 8............	10.39	2.76	51.29	24.48
" 9............	9.96	2.58	48.01	21.77
" 10............	8.01	3.01	55.90	28.30
" 11............	8.70	2.29	42.42	19.05
" 12............	8.72	2.29	42.45	19.08
" 13............	9.74	2.49	46.83	20.40

Consumed in Food — (Continued).

DATE. 1883.	Albuminoids. Lbs.	Fat. Lbs.	Nitrogen — free extract. Lbs.	Crude fibre. Lbs.
January 14	9.77	2.50	47.06	20.59
" 15	8.94	2.82	28.21	20.38
" 16	15.71	5.22	47.59	19.51
" 17	10.97	3.74	37.20	18.26
" 18	13.40	4.52	41.11	17.55
" 19	12.29	4.16	39.98	16.60
" 20	5.88	2.72	44.31	15.22
" 21	6.00	2.77	45.21	15.96
" 22	5.88	2.72	44.31	15.22
" 23	5.57	2.63	42.61	13.80
" 24	5.71	2.65	43.02	14.16
" 25	6.00	2.77	45.21	15.96
" 26	5.25	1.89	30.25	7.87
" 27	5.17	1.86	29.69	9.41
" 28	5.26	1.90	30.34	9.94
" 29	2.72	1.38	17.89	7.54
" 30	3.21	1.68	22.17	10.42
" 31	3.02	1.61	20.79	9.31
February 1	3.28	1.84	22.61	9.79
" 2	3.30	1.85	22.71	9.86
" 3	3.30	1.85	22.71	9.86
" 4	2.56	1.55	16.35	11.36
" 5	2.89	1.75	18.39	12.78
" 6	3.53	2.13	22.48	15.62
" 7	3.75	2.26	23.89	15.89
" 8	3.86	2.34	24.72	17.17
" 9	3.87	2.34	24.70	17.15
" 10	3.60	2.27	22.95	15.94
" 11	3.61	2.19	23.14	16.17
" 12	7.42	2.61	46.81	23.82
" 13	6.24	2.12	46.01	23.16
" 14	6.35	2.17	46.86	23.86
" 15	6.55	2.26	48.35	25.09
" 16	6.51	2.23	47.95	24.76
" 17	6.61	2.28	48.80	25.47

The Four Cows Yield.

DATE. 1883.	MILK YIELD. A. M. Lbs.	P. M. Lbs.	DAY'S YIELD. P. M. & A. M. Lbs	A. M. & P. M. Lbs.	Butter yield by churn. Ounces.	Fat yield by analysis. Ounces.
Jan. 2....	35.88	21.50	58.25	57.38	......	....
" 3....	31.81	23.69	53.31	55.50	38.75	43.67
" 4....	32.75	22.69	56.44	55.44	*23.25	45.96
" 5....	33.19	23.06	55.88	56.25	43.75	45.86
" 6....	32.75	22.06	55.81	54.81	46.75	46.16
" 7....	32.44	21.56	54.50	54.00	46.25	46.39
" 8....	33.32	23.31	54.88	56.63	44.00	46.45
" 9....	33.44	22.00	56.75	55.44	45.25	48.48
" 10....	31.88	23.19	53.88	55.07	44.00	46.46
" 11....	30.81	21.94	54.00	52.75	51.00	49.85
" 12....	29.62	20.69	51.56	50.31	49.25	48.26
" 13....	30.13	19.50	50.82	49.63	45.25	48.70
" 14....	31.56	21.50	51.06	53.06	47.50	47.14
" 15....	33.88	21.81	55.38	55.69	*28.50	49.79
" 16....	35.25	24.63	57.06	59.88	42.00	46.65
" 17....	36.06	27.07	60.69	63.13	35.00	57.94
" 18....	37.56	25.25	64.63	62.81	34.75	48.87
" 19....	37.06	27.38	62.31	64.44	33.25	46.02
" 20....	37.18	27.38	64.56	64.56	38.50	46.79
" 21....	40.25	25.06	67.63	65.31	*22.13	48.36
" 22....	37.50	28.00	62.56	65.50	36.50	47.44
" 23....	31.94	24.19	59.94	56.13	39.75	48.23
" 24....	30.56	23.82	54.75	54.38	33.00	43.09
" 25....	30.43	22.13	54.25	52.56	39.75	40.01
" 26....	28.75	22.88	50.88	51.63	34.50	39.07
" 27....	29.38	21.75	52.26	51.13	36.25	42.30
" 28....	27.81	21.81	49.56	49.62	38.25	42.18
" 29....	31.75	22.00	53.56	53.75	35.50	42.59
" 30....	27.69	21.31	49.69	49.00	35.50	42.85
" 31....	27.94	21.75	49.25	49.69	35.00	41.92
Feb. 1....	28.50	21.31	50.25	49.81	29.75	39.71
" 2....	28.63	19.25	49.94	47.88	31.25	40.35
" 3....	27.38	19.81	46.63	47.19	31.25	38.12
" 4....	29.13	16.31	48.94	45.44	28.75	39.61
" 5....	24.19	17.06	40.50	41.25	31.75	34.86
" 6....	23.06	17.13	40.12	40.19	30.00	32.36
" 7....	22.68	15.63	39.81	38.31	31.25	31.46
" 8....	21.25	16.69	36.88	37.94	27.50	29.14
" 9....	21.31	15.31	38.00	36.62	27.75	30.64
" 10....	20.63	15.25	35.94	35.88	25.50	27.31
" 11....	19.81	13.81	35.06	33.62	25.75	27.76

* Rejected and new figures interpolated in making up averages.

The Four Cows Yield — (Continued).

DATE. 1883.	MILK YIELD.		DAY'S YIELD.		Butter yield by churn. Ounces.	Fat yield by analysis. Ounces.
	A. M. Lbs.	P. M. Lbs.	P. M. & A. M. Lbs.	A. M. & P. M. Lbs.		
Feb. 12....	20.94	14.50	34.75	35.44	28.00	27.85
" 13....	21.00	16.81	35.50	37.81	26.25	28.05
" 14....	22.94	17.75	39.75	40.69	27.50	29.57
" 15....	23.75	20.06	41.50	43.81	31.75	32.40
" 16....	24.63	19.75	44.69	44.38	*34.53	38.04
" 17....	26.38	19.19	46.13	45.57	36.25	36.46
" 18....	27.44	19.31	46.63	46.75	36.50	36.25

Milk Analysis — Mixed Evening and Morning Milk.

DATE. 1883.	Specific gravity.	Per cent cream.	Total solids per cent.	Solids not fat per cent.	Per cent butter by churn.	Per c't fat by analysis.
January 3.........	1.0317	14.25	14.41	9.29	4.54	5.12
" 4........	1.0322	17.05	14.43	9.32	2.57	5.09
" 5.........	1.0321	17.75	14.33	9.20	4.81	5.13
" 6.........	1.0323	15.45	14.57	9.40	5.23	5.17
" 7.........	1.0320	14.50	14.88	9.67	5.30	5.32
" 8.........	1.0326	13.50	14.83	9.54	5.01	5.29
" 9.........	1.0324	14.00	14.72	9.38	4.98	5.34
" 10.........	1.0329	13.50	14.78	9.39	5.09	5.39
" 11.........	1.0316	16.00	15.04	9.27	5.90	5.77
" 12.........	1.0313	15.50	15.17	9.32	5.97	5.85
" 13.........	1.0311	16.00	15.51	9.52	5.56	5.99
" 14.........	1.0322	14.50	15.21	9.44	5.81	5.77
" 15.........	1.0323	14.00	15.14	9.52	*3.21	5.62
" 16.........	1.0321	12.75	14.31	9.20	4.60	5.11
" 17.........	1.0308	14.50	14.33	8.95	3.62	5.38
" 18.........	1.0302	13.50	13.89	9.14	3.37	4.75
" 19.........	1.0302	13.50	13.69	9.10	3.31	4.57
" 20.........	1.0305	12.75	13.60	9.07	3.72	4.53
" 21........	1.0307	13.00	13.89	9.42	*2.04	4.47
" 22........	1.0320	15.25	14.64	9.90	3.64	4.74
" 23.........	1.0321	15.25	14.61	9.58	4.14	5.03
" 24.........	1.0322	13.50	14.54	9.62	3.76	4.92
" 25.........	1.0326	12.50	14.36	9.75	4.58	4.61

* Rejected and new figures interpolated in making up averages.

Milk Analysis — Mixed Evening and Morning Milk — (Continued).

DATE. 1883.	Specific gravity.	Per cent cream.	Total solids per cent.	Solids not fat per cent.	Per cent butter by churn.	Per c't fat by analysis.
January 26	1.0321	14.50	14.31	9.51	4.23	4.80
" 27	1.0323	14.00	14.74	9.68	4.33	5.06
" 28	1.0317	14.25	14.80	9.49	4.82	5.32
" 29	1.0324	13.00	14.61	9.64	4.14	4.97
" 30	1.0313	13.50	14.90	9.51	4.46	5.39
" 31	1.0310	13.25	14.98	9.66	4.44	5.32
February 1	1.0314	12.00	14.15	9.21	3.70	4.94
" 2	1.0312	12.50	14.21	9.18	3.91	5.05
" 3	1.0316	11.75	14.40	9.29	4.19	5.11
" 4	1.0314	11.50	14.40	9.34	3.67	5.06
" 5	1.0318	12.50	14.74	9.49	4.90	5.25
" 6	1.0307	12.50	14.32	9.28	4.67	5.04
" 7	1.0309	12.25	14.18	9.25	4.90	4.94
" 8	1.0307	13.00	14.15	9.21	4.66	4.94
" 9	1.0303	13.00	14.13	9.09	4.56	5.04
" 10	1.0309	12.00	13.93	9.18	4.26	4.75
" 11	1.0304	12.75	14.00	9.05	4.94	4.95
" 12	1.0311	13.00	14.21	9.20	5.03	5.01
" 13	1.0314	13.50	14.20	9.26	4.62	4.94
" 14	1.0317	12.75	13.82	9.17	4.32	4.65
" 15	1.0312	14.75	14.11	9.23	4.78	4.88
" 16	1.0315	15.00	14.84	9.93	4.83	5.32
" 17	1.0307	15.00	14.44	9.50	4.91	4.94
" 18	1.0316	14.00	14.27	9.41	4.89	4.86

Milk Analysis — Mixed Evening and Morning Milk.

DATE. 1883.	Water, per cent.	Fat, per cent.	Protein, per cent.	Milk sugar, per cent.	Ash, per cent.
January 3	85.59	5.12	3.96	4.71	.66
" 4	85.57	5.09	3.61	5.15	.68
" 5	85.67	5.13	3.67	4.89	.64
" 6	85.43	5.17	3.75	4.91	.74
" 7	85.12	5.32	....	....	.74
" 8	85.17	5.29	3.93	4.88	.73
" 9	85.28	5.34	3.67	5.01	.70
" 10	85.22	5.39	3.67	5.02	.68
" 11	84.96	5.77	3.80	5.15	.61
" 12	84.83	5.85	3.80	5.15	.70

Milk Analysis — Mixed Evening and Morning Milk — (Continued).

DATE. 1883.		Water, per cent.	Fat, per cent.	Protein, per cent.	Milk sugar, per cent.	Ash, per cent.
January	13..........	84.49	5.99	3.86	5.19	.65
"	14..........	84.79	5.77	....	....	.62
"	15..........	84.86	5.62	....	....	.65
"	16..........	85.68	5.11	3.86	4.64	.71
"	17..........	85.67	5.38	3.55	5.21	.64
"	18..........	86.11	4.75	3.42	5.16	.67
"	19..........	86.31	4.57	3.55	4.90	.67
"	20..........	86.40	4.53	3.42	4.97	.68
"	21..........	86.11	4.47	....	....	.63
"	22..........	85.36	4.74	3.75	5.13	.68
"	23..........	85.39	5.03	3.75	5.21	.71
"	24..........	85.46	4.92	3.75	5.17	.70
"	25..........	85.64	4.61	3.75	5.31	.69
"	26..........	85.69	4.80	3.67	5.18	.66
"	27..........	85.26	5.06	3.80	5.14	.67
"	28..........	85.20	5.32	....	....	.67
"	29..........	85.39	4.97	3.83	5.13	.68
"	30..........	85.10	5.39	3.75	5.07	.69
"	31..........	85.02	5.32	3.61	5.37	.68
February	1..........	85.85	4.94	3.36	5.18	.67
"	2..........	85.79	5.05	3.42	5.09	.65
"	3..........	85.60	5.11	3.43	5.17	[illegible]
"	4..........	85.60	5.06	....	....	.66
"	5..........	85.26	5.25	3.44	5.49	.56
"	6..........	85.68	5.04	3.33	5.30	.65
"	7..........	85.82	4.94	3.28	5.33	.63
"	8..........	85.85	4.94	3.41	5.20	.60
"	9..........	85.87	5.04	3.25	5.24	.60
"	10..........	86.07	4.75	3.25	5.28	.65
"	11..........	86.00	4.95	....	....	.69
"	12..........	85.79	5.01	3.33	5.28	.69
"	13..........	85.80	4.94	3.45	5.15	.66
"	14..........	86.18	4.65	3.44	5.05	.68
"	15..........	85.89	4.88	3.36	5.27	.60
"	16..........	85.16	5.32	3.30	5.56	.66
"	17..........	85.56	4.94	3.55	5.28	.67
"	18..........	85.73	4.86	3.42	5.32	.67

Daily Average for Whole Period.

PERIOD.	DATE. 1883.	Total food consumed. Lbs.	Water drank. Lbs.	Excrement. Lbs.	Weight of cows. Lbs.
I....	January 1-7....	101.07	254.71	219	2828
II....	" 8-14....	95.96	260.32	233.1	2893
III....	" 15-19....	87.94	215.77	210.2	2848
IV....	" 20-25....	84.57	209.02	180.7	2843
V....	Jan. 26 to Feb. 3.	108.22	102.13	137.2	2744
VI....	February 4-11...	216.00	10.75	146.5	2785
VII....	" 12-17...	84.57	202.07	191	2749

Daily Average for Last Three Days of Each Period.

PERIOD.	DATE. 1883.	Total food consumed. Lbs.	Water drank. Lbs.	Excrement. Lbs.	Weight of cows. Lbs.
I ...	January 5-7....	99.87	252.54	228.3	2838
II....	" 12-14....	95.69	254.89	234.6	2882
III....	" 17-19....	84.08	219.65	173.6	2849
IV....	" 23-25....	83.33	194.27	173.6	2822
V....	February 1-3....	135.68	50.40	118.6	2713
VI....	" 9-11....	230.89	4.79	162	2820
VII....	" 15-17....	83.48	218.13	188.3	2740

Daily Average of Each Whole Period.

PERIOD.	DATE. 1883.	Dry food consumed. Lbs.	Water in food. Lbs.	Total water in food and drink. Lbs.	Albumenoid in food consumed. Lbs.	Fat in food consumed. Lbs.	Crude fibre in food consumed. Lbs.	Nitrogen-free extract in food consumed. Lbs.
I.....	Jan. 2-7..	86.02	15.05	269.76	7.40	2.68	24.71	48.69
II.....	" 8-14.	82.53	13.46	273.78	9.33	2.56	21.95	47.71
III.....	" 15-19.	78.30	9.64	225.41	12.26	4.09	18.46	38.81
IV.....	" 20-25.	70.43	14.14	223.16	5.84	2.71	15.05	44 11
V.....	Jan. 26 to Feb. 3..	41.96	66.26	168.39	3.83	1.76	9.33	24.35
VI.....	Feb. 4-11.	46.18	169.87	180.62	3.46	2.10	15.26	22.08
VII.....	" 12-17.	72.03	12.54	214.61	6.61	2.28	24.36	47.46

Daily Average of Last Three Days of Each Period.

PERIOD.	DATE. 1883.	Dry food consumed. Lbs.	Water in food. Lbs.	Total water in food and drink. Lbs.	Albumenoid in food consumed. Lbs.	Fat in food consumed. Lbs.	Crude fibre in food consumed. Lbs.	Nitrogen—free extract in food consumed. Lbs.
I.....	Jan. 5–7..	84.99	14.88	267.42	7.37	2.74	24.97	46.50
II.....	" 12–14.	82.29	13.39	268.28	9.41	2.43	20.02	45.45
III.....	" 17–19.	75.30	8.78	228.43	12.22	4.14	17.47	39.43
IV.....	" 23–25.	69.33	13.96	208.23	5.76	2.68	14.64	43.61
V.....	Feb. 1–3..	38.41	97.28	147.68	3.29	1.85	9.84	22.68
VI.....	" 9–11.	49.35	181.54	186.33	3.69	2.27	16.42	23.60
VII.....	" 15–17.	71.09	12.39	230.52	6.56	2.26	25.07	48.36

Daily Average for Each Whole Period.

PERIOD.	DATE. 1883.	Evening and morning milk. Lbs.	Cream, per cent.	Fat per cent by analysis.	Butter per cent by churn.	Actual fat by analysis. Ounces.	Actual butter by ch'rn. Ounces.
I.....	Jan. 2–7...	55.14	15.4	5.19	4.91	45.58	43.46
II.....	" 8–14..	53.35	14.8	5.66	5.50	48.38	46.94
III.....	" 15–19..	61.84	13.4	4.87	3.72	49.25	36.70
IV.....	" 20–25..	58.33	14.0	4.76	3.97	44.36	36.83
V.....	January 26 to						
IV.....	Febuary 3.	50.00	12.8	5.14	4.18	41.07	33.50
	Feb. 4–11..	37.63	12.6	4.99	4.74	30.17	29.56
IIV.....	" 12–18..	42.37	14.1	4.93	4.73	33.46	32.13

Daily Average for Last Three Days of Each Period.

PERIOD.	DATE. 1883.	Evening and morning milk. Lbs.	Cream per cent.	Fat per cent by analysis.	Butter per cent by churn.	Actual fat by analysis. Ounces.	Actual butter by ch'rn. Ounces.
I.....	Jan. 5–7...	55.06	14.5	5.26	5.18	46.00	45.66
II.....	" 12–14..	52.42	14.8	5.79	5.54	48.54	46.37
III.....	" 17–19..	67.27	13.2	4.62	3.47	47.23	35.50
IV.....	" 23–25..	53.19	13.5	4.78	4.19	40.72	35.75
V.....	Feb. 1–3...	48.50	11.9	5.07	3.92	39.36	30.42
VI.....	" 9–11..	35.25	12.6	4.90	4.78	27.64	26.42
VII.....	" 15–17..	45.82	14.6	5.04	4.88	36.92	35.76

Daily Average Weight of Cows.

PERIOD.	Ann. Lbs.	Emm. Lbs.	Jem. Lbs.	Meg. Lbs.	Average Lbs.
Period I, January 2–8..........	840	704	601	680	707
First three days, January 2–4...	828	706	596	671	700
Last three days, January 6–8....	847	700	603	691	709
Period II, January 9-15........	860	732	613	687	723
First three days, January 9–11..	857	727	612	703	727
Last three days, January 13–15..	860	737	612	673	720
Period III, January 16–20......	855	715	603	669	712
First two days, January 16–17...	865	714	599	669	709
Last three days, January 18–20..	848	716	606	669	712
Period IV, January 21–26......	869	712	594	668	711
First three days, January 21–23..	866	729	601	668	716
Last three days, January 24–26..	872	695	587	668	705
Period V, Jan. 27 to Feb. 4.....	859	679	573	633	686
First three days, January 27–29..	863	691	581	652	697
Last three day, February 2–4....	858	666	564	625	678
Period VI, February 5–12.......	874	690	585	635	696
First three days, February 5–7...	873	678	574	622	687
Last three days, February 10–12.	883	700	596	642	705
Period VII, February 13–18.....	857	679	577	632	687
First three days, February 13–15.	858	681	580	633	688
Last three days, February 16–18.	856	677	574	631	685

Variations.

DATE. 1883.	MILK YIELD.		CREAM, PER CENT.		SPECIFIC GRAVITY.		TOTAL SOLIDS, PER CENT.	
	A. M. Lbs.	P. M. Lbs.	A. M.	P. M.	A. M.	P. M.	A. M.	P. M.
Jan. 2....	35.88	21.50	....	14.9	......	1.0307	.....	14.45
" 3....	31.81	23.69	13.4	17.3	1.0328	1.0309	14.37	14.56
" 4....	32.75	22.69	16.8	18.5	1.0334	1.0315	14.31	14.34
" 5....	33.19	23.06	17.	14.7	1.0327	1.0313	14.33	14.58
" 6....	32.75	22.06	16.2	15.	1.0333	1.0311	14.56	14.99
" 7....	32.44	21.56	14.	15.5	1.0329	1.0319	14.76	15.39
" 8....	33.32	23.31	11.5	15.	1.0333	1.0319	14.28	14.93
" 9....	33.44	22.00	13.	14.	1.0328	1.0335	14.52	14.94

Variations — (Continued).

DATE. 1883.	Milk Yield. A. M. Lbs.	Milk Yield. P. M. Lbs.	Cream, Per Cent. A. M.	Cream, Per Cent. P. M.	Specific Gravity. A. M.	Specific Gravity. P. M.	Total Solids, Per Cent. A. M.	Total Solids, Per Cent. P. M.
Jan. 10....	31.88	23.19	13.	17.	1.0323	1.0309	14.62	15.31
" 11....	30.81	21.94	15.	17.	1.0322	1.0308	14.77	15.47
" 12....	29.62	20.69	14.	17.	1.0317	1.0304	14.87	15.66
" 13....	30.13	19.50	15.	17.	1.0317	1.0308	15.36	15.72
" 14....	31.56	21.50	12.	16.	1.0335	1.0322	14.71	15.90
" 15....	33.88	21.81	12.	14.	1.0324	1.0317	14.39	14.56
" 16....	35.25	24.63	11.5	16.	1.0325	1.0300	14.07	14.94
" 17....	36.06	27.07	13.	14.	1.0315	1.0296	13.72	14.13
" 18....	37.56	25.25	13.	14.5	1.0308	1.0297	13.65	14.05
" 19....	37.06	27.38	12.5	14.	1.0307	1.0301	13.33	13.88
" 20....	37.18	27.38	11.5	14.	1.0308	1.0296	13.32	14.52
" 21....	40.25	25.06	12.	17.	1.0318	1.0322	13.26	15.12
" 22....	37.50	28.00	13.5	17.5	1.0318	1.0306	14.16	15.08
" 23 ...	31.94	24.19	13.	15.	1.0336	1.0314	14.14	14.82
" 24....	30.56	23.82	12.	13.	1.0330	1.0322	14.27	14.55
" 25....	30.43	22.13	12.	15.	1.0330	1.0315	14.17	14.18
" 26....	28.75	22.88	14.	15.	1.0327	1.0312	14.45	14.89
" 27....	29.38	21.75	13.	14.5	1.0334	1.0313	14.59	14.84
" 28....	27.81	21.81	14.	14.	1.0320	1.0320	14.77	15.27
" 29....	31.75	22.00	12.	15.	1.0327	1.0303	13.96	14.94
" 30....	27.69	21.31	12.	15.	1.0322	1.0297	14.86	15.23
" 31....	27.94	21.75	11.5	14.	1.0323	1.0305	14.73	14.66
Feb. 1....	28.50	21.31	10	13.	1.0323	1.0306	13.65	14.36
" 2 ..	28.63	19.25	12.	13.5	1.0318	1.0311	14.09	14.86
" 3....	27.38	19.81	10.	13.	1.0320	1.0313	13.95	14.79
" 4....	29.13	16.31	10.	15.	1.0314	1.0312	14.02	15.68
" 5....	24.19	17.06	10.	14.	1.0323	1.0304	13.81	14.69
" 6....	23.06	17.13	11.	13.5	1.0310	1.0305	13.95	14.66
" 7 ...	22.68	15.63	11.	13.5	1.0313	1.0306	13.71	14.34
" 8....	21.25	16.69	12.5	13.	1.0307	1.0301	13.97	14.12
" 9....	21.31	15.31	13.	13.	1.0304	1.0306	14.14	14.11
" 10....	20.63	15.25	11.	14.	1.0312	1.0302	13.75	14.32
" 11....	19.81	13.81	11.5	14.	1.0305	1.0309	13.69	14.60
" 12....	20.94	14.50	12.	15.	1.0312	1.0309	13.82	14.50
" 13....	21.00	16.81	12.	12.5	1.0319	1.0315	13.90	13.72
" 14....	22.94	17.75	13.	15.5	1.0318	1.0305	13.93	14.37
" 15....	23.75	20.06	14.	16.	1.0318	1.0308	13.86	14.91
" 16....	24.63	19.75	14.	15.5	1.0322	1.0306	14.78	14.79
" 17....	26.38	19.19	14.5	14.	1.0307	1.0314	14.09	14.25
" 18....	27.44	19.31	14.	....	1.0318	......	14.27	.....

Analysis of Foods Fed.

	Water.	Ash.	Albuminoids.	Fibre.	Nitrogen-free extract.	Fat.
Hay	13.88	4.88	5.38	33.33	40.32	2.21
Shorts (January 2–10)	14.24	5.69	15.33	7.53	54.26	2.95
Shorts (January 11 to February 9)	14.13	5.26	14.64	7.87	55.25	2.85
Shorts (February 10–18)	14.28	5.08	14.89	7.50	55.62	2.63
Corn meal (January 2 to February 9	19.98	1.18	8.65	.50	65.35	4.34
Corn meal (February 10–18	18.44	1.20	8.82	.51	66.61	4.42
Gluten meal	7.31	.74	28.03	.73	54.46	8.73
Ensilage	78.61	1.50	1.60	7.10	10.22	.97

Our first discussion must be upon the weight of the cows. As Period I and Period VII are duplicates, we can use them for comparison. We note that although the same materials were fed, yet the amount consumed varies, and that the totals of weights of cows and products differ. This difference is important as indicating the limits within which our figures can be used. Thus, taking the last three days of each period, we find that the cows gained upon the assumed normal weight twenty-six pounds during Period I, and lost eighty-two pounds during Period VII. This variation of one hundred and eight pounds must arise from the imperfection of the method of calculating gain or loss from the daily live weight of the animals, or from effect of previous feeding. During Period I, comparing the weights of the first and last three days, the gain of the last three over the first three is twenty-nine pounds; during Period VII, the loss in the last three over the first three days is twenty-nine pounds.

The changes of weight which occurred from the assumed normal weight of two thousand eight hundred and twelve pounds is expressed below in + and — signs.

PERIOD.	For three last days.	For average of period.
I	+26 lbs.	+16 lbs.
II	+60 "	+81 "
III	+37 "	+36 "
IV	+10 "	+21 "
V	—99 "	—68 "
VI	+ 8 "	—27 "
VII	—82 "	—63 "

We may supplement the above by a table representing the variation of each cow during each period of three days, from the average weight of the period, thus obtaining an expression for the influence of the food used.

PERIOD.	Ann.	Emm.	Jem.	Meg.	Total.
I.	—12	— 1	+11	+33	+31 lbs.
II.	+ 1	+36	+20	+15	+72 "
III.	—11	+15	+14	+11	+29 "
IV.	+13	— 6	— 5	+10	+12 "
V.	— 1	—35	—28	—33	—97 "
VI.	+24	— 1	+ 4	—16	+11 "
VII.	— 3	—24	—18	—27	—72 "
No. of gaining periods.	3	2	4	4	5
No. of losing periods..	4	5	3	3	2

Remembering that the variation which may be expected from this method of estimating true live weight may be twenty-seven pounds per cows, or one hundred and eight pounds for the four cows, we may interpret these results as below.

1st. A maintenance ration was being fed during Period VI, the ensilage period.

2d. During Periods II, III and IV, the rations were slightly above the maintenance requisite.

3d. That during Period V the rations were slightly below the maintenance requisite.

4th. That although a maintenance ration was fed during Periods I and VII, yet maintenance was not alike maintained in Period VII, either through inability of the cows to digest or as an effect of the previous feeding.

The value of the various rations consumed differ widely as estimated in the German method. Thus, taking the figures of digestibility as given in the German tables, estimating the ensilage as maize fodder and the gluten meal as meal, we have—

	Digestible food consumed daily, the several periods, per cow.						
PERIODS.	I.	II.	III.	IV.	V.	VI.	VII.
Digestible protein, lbs	1.20	1.53	2.87	1.01	.62	.67	1.25
Digestible fat, lbs	.41	.40	.91	.30	.36	.42	36
Digestible carbo-hydrates, lbs	11.78	10.32	10.14	9.81	6.80	6.90	11.94
Total nutritive substance, lbs	13.39	12.25	13.92	11.12	7.78	7.99	13.55
Total dry matter, lbs	21.25	20.57	18.82	17.33	9.53	12.34	17.79
Nutritive ratio	1:10.33	1:7.4	1:4.3	1:10.4	1:12.4	1:11.8	1:10.3

An inspection of this table at once shows that for maintenance of live weight ensilage ranks as an economical food. We would warn, however, against the deduction that our feeding could be continued for an unlimited period without injury or loss of weight; it is probable, indeed, what our figures are not intended to show, that the value of ensilage must be as a supplement to other foods.

According to Wolff's tables the best feeding ration for milch cows, and for oxen at rest in stalls, as calculated for animals of seven hundred pounds weight, should be:

	Wolff's feeding ration for 700 pound animals.	
	For milch cows.	For oxen at rest in stalls
Digestible protein, lbs	1.92	0.49
Digestible fat, lbs	0.30	0.10
Digestible carbo-hydrates, lbs	9.62	5.60
Total nutritive substance, lbs	11.84	6.19
Total dry matter, lbs	18.48	12.25
Nutritive ratio	1:5.4	1:12

As has been shown by the German experimenters, the increase in live weight may arise in various ways—such as absorption of water in the tissues, a weight not retained well; such as the retention of undigested material from day to day, etc. Hence the data upon which our tables must be studied is in part as below.

1st. A certain minimum supply of albuminoid is necessary to prevent starvation of the animal, while an increase of the supply above this quantity causes a slight gain of flesh for a short time, until finally exactly as much nitrogen is excreted in the excrement and milk as is taken in the food.

2d. Where water is supplied much of it may be laid up in the tissues and the live weight of the animal increased.

3d. According to the observations of Henneberg, in Weende, on oxen, when the amount of water was increased 22.4 per cent, the increase of the protein consumption, *i. e.*, the quantity of albuminoid matter daily destroyed in the vital processes, and appearing in the urine as urea, averaged 5.8 per cent, an amount equal to one-third, or perhaps even one-half of the albuminoid, which otherwise might have been deposited in the body.

4th. The influence of the preceding food extends from two to four days from the change in the feeding, yet we may consider it doubtful whether the influence of the preceding food in the case of ruminants may not extend over a much longer period.

5th. The effect of the addition of carbo-hydrates is to decrease the protein consumption, and thus to cause the albuminoid of the food to go further toward the laying on of flesh.

6th. The albuminoid of the ration which enters into the formation of structure in the body becomes quite stable, and a gain of flesh caused in this way may continue for a comparatively long time. That is to say, speaking comparatively, that while an increase in weight gained by the water laid up in the tissue of the animals is easily lost, the increase in weight gained by the feeding of protein and carbo-hydrates is lost less readily; the increase of weight produced by the adding of fat to the ration is lost with yet more difficulty.

7th. The daily weighings of an animal, or the apparent increase or decrease of live weight, does not indicate the value of the change, as the variation may come about through the greater or less amount of water absorbed within the tissues, or the variation in the amount of undigested food. We hence must allow in our computations for quite a wide variation between the daily weights as coming within the errors which are necessitated by this method.

If we place the total water consumed daily in our trial in one column and the albuminoid consumed in another we have:

PERIOD.	Water consumed.	Albuminoid consumed.	Nutritive ratio.
I	267.42 lbs.	1.20 lbs.	1:16
II	268.28 lbs.	1.53 lbs.	1:7.4
III	228.43 lbs.	2.87 lbs.	1:4.3
IV	208.23 lbs.	1.01 lbs.	1:10.4
V	147.68 lbs.	.62 lbs.	1:12.4
VI	186.33 lbs.	.67 lbs.	1:11.8
VII	230.52 lbs.	1.25 lbs.	1:10.3

During the gaining periods we observed that as the water consumed diminishes less albuminoid is required, a result in general corresponding to those obtained by Henneberg. The application of this remark to ensilage is evident: Through the less water drank when ensilage is fed, and the less amount of water daily consumed the albuminoid of the ensilage becomes of greater avail toward maintenance of weight.

In order to justify our assumption that a maintenance ration of ensilage was being fed, we may have recourse to the absolute method, as follows:

Nitrogen consumed		.5910 lbs.
Nitrogen recovered in excrement	.3564	
Nitrogen recovered in milk	.1833	
Total nitrogen recovered		.5397 lbs.
Nitrogen unaccounted for		.0513 lbs.

This .0513 lbs. of nitrogen represents a gain in weight of the cow of one and one-half pounds of flesh.

For studying the milk yield we bring together the following figures for the last three days of each period for the four cows:

PERIOD.	Milk per day, lbs.	Dry matter of milk, lbs.	Dry matter of milk, per cent.
I	55.06	8.12	14.76
II	52.42	8.01	15.28
III	67.27	9.23	13.73
IV	53.19	7.66	14.40
V	48.50	6.95	14.34
VI	35.25	4.95	14.04
VII	45.82	6.71	14.65

As Periods I and VII are under like feeding we have in their difference a means of obtaining the depression in milk yield which we may assume to be that caused by the progress of lactation. We can hence construct a table of assumed normal yields for each period for comparison with the actual yields, in order to obtain the gain or loss to be ascribed to the food used. We also add a column showing the amount of albuminoid digested during each period, according to the German tables:

PERIOD.	Assumed normal milk yield, lbs.	Actual yield, lbs.	Gain or loss, lbs.	Albuminoid digested, lbs.	Nutritive ratio.
I	55.06	55.06	....	4.80	1:10.3
II	53.31	52.42	— 0.89	6.12	1: 7.4
III	52.06	67.27	+ 15.21	11.48	1: 4.3
IV	50.56	53.19	+ 2.63	4.04	1:10.4
V	48.32	48.50	+ 0.18	2.48	1:12.4
VI	46.33	32.25	—11.08	2.68	1:11.8
VII	45.82	45.82	....	5.00	1:10.3

We may infer from these tables the following conclusions:

The average amount of dry matter in the milk is one pound to 6.91 pounds of milk; the variation during the seven periods from this average is but .37 pounds, or about five per cent either way from the average. This indicates that the average composition of the total milk for the day is nearly unaffected by the changes in the fodder, although the

table of percentages of dry matter would indicate a variation from period to period in the constituents of a given quantity of milk.

While there is not indication of a constant ratio between the albuminoid consumed and the yield of milk yet in the case of the largest consumption of albuminoid, the milk yield was also the greatest; when the same amount of albuminoid was consumed in Periods V and VI there was a gain of milk in one case and a loss in the other; but Period V was a transition period, and the influence of a larger previous supply of albuminoid probably exerted an effect on the yield.

During Period II, hay and bran being fed, and Period VI, ensilage being fed, there was a loss in milk yield. During Period III, hay and gluten meal fed, the largest gain in milk, and during Period IV, hay and meal feeding, also a gain. The indications are here favorable to the use of meal as a milk-yielding food, and more particularly to gluten meal. The advantage of ensilage as a milk-yielding food is not apparent.

For the study of the influence of the food, if any, upon the butter, we may use the following figures:

PERIOD.	Daily milk yield, lbs.	Total fat, ozs.	Total butter obtained, ozs.	Fat, per cent.	Butter, per cent.	Fat, calculated for milk containing 86 per cent of water.
I..............	55.06	46.00	45.66	5.26	5.18	5.03
II..............	52.42	48.54	46.37	5.79	5.54	5.30
III..............	67.27	47.23	35.56	4.62	3.47	4.63
IV	53.19	40.72	35.75	4.78	4.19	4.61
V..............	48.50	39.36	30.42	5.07	3.92	4.97
VI..............	35.25	27.64	26.42	4.90	4.78	4.89
VII..............	45.82	36.92	35.76	5.04	4.88	4.83

By reducing the milk to a uniform water content of eighty-six per cent, we eliminate the influence of a varying percentage of water in the natural milk. We find in this column the average to be 4.89 per cent, the extremes 5.30 and 4.61 per cent, and the variation 14.2 per cent from the average. In Kuhn's experiment of like character the variation was 13.3 per cent from the average. We may thus infer that when the milk is calculated to a uniform water content the proportion of the fat present under different but full feeding may be practically the same. In Kuhn's case there was a slight increase in the relative proportion of fat when palm kernel cake was fed; in our case a slight increase when wheat bran was fed, while under an insufficient ration during Period V the percentage of fat was greater than under a maintenance ration during Periods III, IV, VI and VII, and this circumstance but adds force to the general conclusion.

When, however, we come to the column of total fat contained in the daily milk, in ounces, as determined by analysis, we note a wide variation, the extremes being 48.54 ounces and 27.64 ounces, or a variation from the average of 51 per cent, the fat neither following closely the amount of milk yielded nor the albuminoid in the rations. We can arrange a new table which will show this.

PERIOD.	Albuminoid consumed, lbs.	Fat yielded, lbs.	Ounces fat to one pound albuminoid consumed.
III..........................	12.22	47.23	3.86
II..........................	9.41	48.54	5.15
I..........................	7.37	46.00	6.24
VII..........................	6.56	36.92	5.62
IV..........................	5.76	40.72	7.07
VI..........................	3.69	27.64	7.49
V..........................	3.29	39.36	11.96

The last column indicates that during Period V a maintenance ration was not being fed, as was truly the case, and that the butter fat was being formed from previously stored food. The whole table also gives evidence as to the value of wheat bran as a butter-fat yielding food for cows. It seems also indicated that during Period III more albuminoid was being fed than the cows could utilize in building up the butter product.

The columns indicating the ounces of butter in the milk of each day as determined by analysis, and the butter actually obtained by the churn, are very instructive. During the whole of the seven periods the average ounces of butter in the daily milk was 40.91; the average ounces of butter obtained by daily churning was 36.55. The period variation of the fat in the milk can best be seen in tabular form.

PERIOD.	Total fat, ozs.	Total butter, ozs.	Difference, ozs.	Albuminoid eaten, lbs.
I....................	46.00	45.66	0.34	7.37
II....................	48.54	46.37	2.17	9.41
III....................	47.23	35.50	11.73	12.22
IV....................	40.72	35.75	4.97	5.76
V....................	39.36	30.42	8.94	3.29
VI....................	27.64	26.42	1.22	3.69
VII....................	39.92	35.76	1.16	6.56
Average...........	40.91	36.55	3.36	.....

We may hence state with considerable certainty that the amount of protein eaten has far less effect upon the economical butter production than it has upon the actual fat production. Indeed, there seems no relation whatsoever, and however the constituent of the food may increase the total fat of the milk, yet the butter which may be obtained from the milks seems more dependent upon the character of, than upon the composition of the food. Let us illustrate this important discovery by an additional table, calculating the fat and the butter obtained for a milk of constant water composition of eighty-six per cent, we have then :

PERIOD.	Calculated to milk 86 per cent water. Actual fat, per cent.	Butter made, per cent.
I.................................	5.03	4.95
II.................................	5.30	5.07
III.................................	4.63	3.47
IV.................................	4.61	4.04
V.................................	4.97	3.84
VI.................................	4.89	4.77
VII.................................	4.83	4.68
Average.........................	4.89	4.40
Per cent variation from average....	14.2	36.3

As in the case of the actual fat obtained our conclusions must be in accord with German experience, that under circumstances of equal content of water to the milk, the fodder can be proved to affect the fat of the milk to none, or but very slight extent; in the case of the

butter yield of the milk, however, we discover that the fodder ration employed has a large influence, and this influence not so much dependent upon the nutritive property of the food as upon the character of the food used.

We will now return to our column of differences between the total fat and the total butter of the milk in ounces. We first note that Period III, the hay and gluten feeding, shows a great waste in butter; that Period V, the transition period, when the ration was insufficient, also a large waste; that Period IV, the hay and meal feeding, also shows waste to a large extent; that Period II, the hay and bran feeding, far less waste; Period VI, ensilage feeding, still less waste; and Periods I and VII, hay, bran and meal feeding, scarcely any. We can see then that when meal is added to the ration, Periods I, IV and VII, the waste averaged 2.16 ounces; where bran was added to the ration, Periods I, II and VII, the waste averaged but 1.22 ounces. In the case of hay and meal, Period IV, 4.97 ounces; in the case of hay and bran, Period II, 2 1.17 ounces. We must thus believe that the adding of bran to the meal feeding was advantageous to butter recovery from the milk, and that bran is more economical for butter recovery than meal. And this conclusion becomes evident, however the figures may be investigated. Examination of the tables representing the actual fat and butter recovered under the milk calculated to uniform water content shows that gluten meal and meal fed alone with hay was unfavorable toward butter recovery, and that the adding of bran to the ration was advantageous. Perhaps we shall be justified in repeating ourselves somewhat by again showing this fact by a table.

PERIOD.		Milk calculated to a constant water content of 86 per cent.	
		Diff. in per cent between per ct. actual fat and per ct. butter made.	Per cent of butter made to per cent of fat present.
I.	Hay, meal, bran	.08	98.40
II.	Hay, bran	.23	95.66
III.	Hay, gluten meal	1.16	74.73
IV.	Hay, meal	.57	87.63
V.	Transition, per meal ensilage	1.13	77.26
VI.	Ensilage	.12	97.54
VII.	Hay, meal, bran	.15	96.90

We have as the basis for this table an artificially produced uniformity for the purposes of comparison, and in the table the variations which are produced by the character — not the composition — of the food used. In Periods I and VII, the same food being offered, the variations between the butter records give us 98.40 per cent — 96.90 per cent = 1.50 per cent as the limit of error, and this is 1.53 per cent variation from the average for the periods. Assuming then that under hay, meal and bran feeding (6.96 pounds albuminoid), the recovery of butter from the fat was 97.65 per cent we note that when hay and bran was fed (9.41 pounds albuminoid), 95.66 per cent of the fat appeared as butter; where hay and meal was fed (5.76 per cent of albuminoid), but 87.63 per cent in the butter column, etc. Thus, re-arranging our figures:

	Butter, per cent of fat figures.
Hay and bran (9.41 lbs. albuminoid)	95.66
Hay and meal (5.76 lbs. albuminoid)	87.63
Hay, bran, meal (6.96 lbs. albuminoid)	97.65
Hay, gluten meal (12.22 lbs. albuminoid)	74.73
Meal and ensilage (3.29 lbs. albuminoid)	77.26
Ensilage (3.69 lbs. albuminoid)	97.54

In the fat of the milk, reduced to constant water content, the food does not much influence the amount of fat, as we have shown before. In the butter obtained from this same fat we find a variation between the per cents of butter made from the fat of 22.92.

The teaching of this result is again that under equivalent conditions of churning, the character of the food, rather than the composition of the food, influences the amount of butter obtained.

INFLUENCE OF SALT.

As the cows received two ounces each of salt each Sunday, we have the following table to represent its apparent influence:

	Weight of the four cows. Morning preceding salt.	Morning following salt.
January 7	2828 lbs.	2878 lbs.
January 14	2875 "	2898 "
January 21	2872 "	2900 "
January 28	2783 "	2821 "
February 4	2702 "	2709 "
February 11	2826 "	2803 "
Average	2814 lbs.	2835 lbs.

Thus showing that the first effect of salt was to increase the apparent weight.

The water drank by the cows the evening preceding the giving of the salt, and the evening following, and the amount of dry food consumed the day preceding and the day following the salt is given below:

	Weight of water drank. Evening before salting.	Evening after salting.
January 7	71.19 lbs.	116.62 lbs.
January 14	137.75 "	199.25 "
January 21	111.81 "	176.62 "
January 28	65.93 "	100.00 "
February 4	30.43 "	24.25 "
February 11	0.00 "	0.00 "
Average	69.52 lbs.	102.79 lbs.

	Dry matter in food consumed. Day preceding.	Dry matter in food consumed. Day salted.
January 7........	86.88 lbs.	83.38 lbs.
January 14...........................	84.60 "	85.09 "
January 21...................	70.85 "	72.79 "
January 28...........................	48.62 "	50.02 "
February 4. Food changed on February 4.		
February 11...........................	48.03 "	48.29 "
Average...........................	67.79 "	67.91 "

The effect of the salt is to at once increase the amount of water drank, while the influence is also to increase the amount of dry food consumed to a slight yet apparent extent.

POTATOES.

According to the census for 1880, the potato production of the State of New York was thirty-three million six hundred and forty-four thousand eight hundred and seven bushels from three hundred and forty thousand five hundred and thirty-six acres of ground; exceeding in amount of yield the aggregate for the two next largest potato growing States, Pennsylvania and Ohio, by four million six hundred and forty thousand seven hundred and seventy-three bushels. The importance of the potato crop, as thus shown, justifies the careful attention of the station, whereby it may be ascertained in what way waste can be prevented or crop increased. The amount of seed used per acre may, at a very moderate estimate, be calculated at twelve bushels per acre, or four million eighty-six thousand four hundred and thirty-two bushels for the State. If then by cutting the seed into smaller divisions we can save one-half of this seeding, a very small estimate, without diminishing the crop, we have a saving of over two million bushels, which, at thirty cents a bushel, would represent over $600,000. It is this view of the situation which gives a promience in our experiments to the influence of the seed used. Our last year's experiments showed a manifest gain in quantity and quality of crop from the use of single eyes. This year the verification fails, as ordinary cuts and whole potatoes both yielded larger crops than did the single eyes.

Thus, in plats I. B., one to five, each of one-tenth acre area, three rows were planted with single eyes, three with cut potatoes, and three with whole potatoes. The yield from each of the thirtieths of an acre was as below. The variety, the White Star.

Large Potatoes.

	From single eyes.	Ordinary cuts.	Whole potatoes.
I. B. 1...........	243 lbs. 1 oz.	284 lbs. 8 ozs.	359 lbs. 6 ozs.
I. B. 2...........	205 " 15 ozs.	350 " 12 "	406 " 8 "
I. B. 3...........	272 " 15 "	330 " 12 "	395 " 10 "
I. B. 4...........	281 " 13 "	385 " 4 "	433 " 4 "
I. B. 5...........	366 " 15 "	456 " 15 "	358 " 6 "
	1370 " 11 "	1807 " 11 "	1953 " 2 "

Small Potatoes.

	From single eyes.		Ordinary cuts.		Whole potatoes.	
I. B. 1	73 lbs.	9 ozs.	97 lbs.	10 ozs.	191 lbs.	4 ozs.
I. B. 2	79 "	9 "	94 "	9 "	162 "	0 "
I. B. 3	62 "	6 "	87 "	13 "	130 "	0 "
I. B. 4	45 "	12 "	82 "	3 "	135 "	10 "
I. B. 5	45 "	1 "	67 "	0 "	119 "	12 "
	306 "	5 "	429 "	3 "	738 "	10 "

Rotten Potatoes.

	From single eyes.		Ordinary cuts.		Whole potatoes.	
I. B. 1	74 lbs.	14 ozs.	67 lbs.	2 ozs.	91 lbs.	6 ozs.
I. B. 2	35 "	12 "	33 "	13 "	104 "	13 "
I. B. 3	22 "	15 "	32 "	4 "	100 "	3 "
I. B. 4	37 "	13 "	39 "	0 "	119 "	11 "
I. B. 5	43 "	7 "	70 "	6 "	122 "	11 "
	214 "	13 "	242 "	9 "	538 "	12 "

The summary of the yields, in bushels per acre, is:

SEED USED.	Large.	Small.	Rotten.	Total.
Single eyes	137 bush.	30 bush.	21 bush.	188 bush.
Ordinary cuts	181 "	43 "	24 "	248 "
Whole potatoes	195 "	74 "	54 "	323 "

The per cent of small potatoes and rotten potatoes from each kind of planting is:

SEED USED.	Per cent of Crop Of small potatoes.	Of rotten potatoes.
Single eyes	16	11
Ordinary cuts	17	10
Whole potatoes	23	17

In plats C. seven and C. eight, we had another trial between whole potatoes and single eyes. These twentieths of an acre yielded:

PLAT.	SEED USED.	Yield. Large.	Small.	Rotten.
C. 7	Whole potatoes	487 lbs. 0 ozs.	427 lbs. 12 ozs.	57 lbs. 2 ozs.
C. 8	Single eyes	456 " 4 "	87 " 13 "	26 " 2 "

Calculating these results also to the acre, in bushels, we have:

	Large.	Small.	Rotten.
C. 7. Whole potatoes	162.3 bush.	142.6 bush.	19.0 bush.
C. 8. Single eyes	152.1 "	29.3 "	8.7 "

Reviewing these figures as a whole, we observe that the proportion of small potatoes is less from the single eyes. It also appears that the rotten potatoes are less, but this is perhaps accidental, as this year the rot was very local in its character, varying in abundance most markedly even in adjoining rows.

Despite the apparent result in favor of whole potatoes, as shown not only by the totals, but by each separate trial, we cannot but notice that even on the highly fertilized plats of 1882, the yield was below that obtained from single eyes in some of the other plats, while in the case of the whole potatoes used as seed, the yields in plat I. B. five were the maximum of all our trials. In view of this observation, as also of the uncertainty attending plat experiment, we must consider our results as inconclusive for the purposes of generalization, and conclusive only in the fact that, under the conditions of planting and soil, ordinary cuts and the whole potatoes showed a marked superiority in crop over the single eyes used as seed.

And these remarks lead us naturally to the subject of duplicates. What variation may be expected between plats presumably of equal fertility and planted and treated alike? In C. three, C. eight, and C. twelve, we have such plats, White Star potatoes, single eyes used as seed. The yield from the twentieth of an acre was:

	Yield. Large.		Small.		Rotten.	
C. 3	521 lbs.	12 ozs.	98 lbs.	2 ozs.	197 lbs.	13 ozs.
C. 8	456 "	4 "	87 "	13 "	26 "	2 "
C. 12	575 "	0 "	58 "	3 "	65 "	6 "

Expressing our results in bushels, per acre, we have:

	Large.	Small.	Rotten.	Total.
C. 3	174 bush.	32.7 bush.	65.9 bush.	272.6 bush.
C. 8	152.1 "	29.3 "	8.7 "	190.1 "
C. 12	191.6 "	19.4 "	21.8 "	232.8 "

We find in these figures a variation of 39.5 bushels of good potatoes between the three yields, and 82.5 bushels on the total crop.

Let us observe what the variations are between the halves of each plat, calculating the yields per acre.

		Good potatoes.	Total yield.
C. 3.	Right-hand half	167.5 bush.	270.2 bush.
	Left-hand half	180.3 "	275.0 "
C. 8.	Right-hand half	162.6 "	204.2 "
	Left-hand half	141.6 "	176.0 "
C. 12.	Right-hand half	199.2 "	241.3 "
	Left-hand half	184.1 "	224.4 "

We find here the following variations in the yield of good potatoes and total crop in bushels per acre:

Between the half plats.

C. 3	12.8 bush. good potatoes,	4.8 bush. total yield.
C. 8	21.0 " "	28.2 " "
C. 12	15.1 " "	16.9 " "

From the average of the three plats.

C. 3	1.5 bush. good potatoes,	40.8 bush. total yield.
C. 8	20.4 " "	41.7 " "
C. 12	19.1 " "	1.0 " "

Hence we are to conclude that as the variation from the average of the plats are no greater than the variations within the plats, that these discordant figures are as near duplicates as the circumstances of the case admitted of our obtaining, and if we assume a uniform soil upon our plats it would be logical to figure that unless between opponent plats there was a greater difference than fourteen or fifteen per cent, the figures of the crop could not be interpreted either for or against individual treatment. As a matter of fact, however, the soil of our plats is not of uniform fertility, as appears evident from the study of the crops yielded, as also is certain from the varying quantities of fertilizer which had been previously applied.

The whole interpretation of plat experiments depends upon recognizing the limits of error for each case within which differences of figures can have no exact meaning. The curse of plat experimentation is that this limit of error is liable to be excessive, as in our present case.

In the case of our series I. B., one to five, we have a variation of crop between the five yields from single eyes used as seed of one hundred and thirteen pounds, or forty per cent from the average; between the five yields from ordinary cuts one hundred and seventy-two pounds, or forty-eight per cent from the average; and between the five yields from whole potatoes of seventy-five pounds, or ninteen per cent from the average. The variation from the average of the yields in the three duplicate rows of each plat was for the good potatoes.

	Single eyes.	Ordinary cuts.	Whole potatoes.
I. B. 1	10 per cent.	8 per cent.	25 per cent.
I. B. 2	22 "	8 "	12 "
I. B. 3	13 "	12 "	7 "
I. B. 4	15 "	0 "	5 "
I. B. 5	25 "	8 "	8 "

These two calculations both show that the variation in the yields from the whole potatoes used as seed was less than when single eyes were used, and that ordinary cuts produced the most uniform crop. We must, therefore, conclude that under the methods of planting, and in the soil of this year's trials, single eyes gave less yield than the other kinds of seed used. The order of the figures of crop have, however, a greater significance than the actual amounts. In the five duplicate trials it will be observed that in but one case was the yield from the single eyes in excess over that from the whole potatoes.

Although these plats received no fertilizer this year, yet last year two hundred pounds was applied to I. B. two, four hundred pounds to I. B. three, eight hundred pounds to I. B. four, and sixteen hundred pounds to I. B. five. Let us calculate the gain or loss over the unfertilized plat I. B. one, in bushels:

	Single eyes.	Ordinary cuts.	Whole potatoes.
I. B. 2	—18 bush.	+33 bush.	+23 bush.
I. B. 3	+15 "	+23 "	+18 "
I. B. 4	+29 "	+50 "	+37 "
I. B. 5	+62 "	+86 "	0 "

We find here an influence indicated in the crop for the fertilizer left over, as well marked as might be expected, but yielding no certain information, but only the general value of the fertility present.

Notwithstanding the results of our figures seem against the use of single eyes, yet human nature is so constituted that impressions are apt to have considerable force, even as against facts which seem counter, and hence we at the station, after careful watching of crops for two seasons, are as yet unwilling to acknowledge that single eyes are not preferable as seed. In C. seven, whole potatoes used as seed, and C. eight, single eyes, the variation in the yield of good potatoes is but seven per cent of the average for the two plats, while in each half-plat the variation is fourteen per cent for C. seven, and eight per cent for C. eight. Hence in this latter trial the results cannot be interpreted as unfavorable to the single eyes.

In the experiments of last year we seemed to have certain evidence in favor of eyes cut deeply from the substance of the potato as against eyes cut shallow. In our plats C. eight, C. nine and C. ten we this year sought to obtain verification of the hypothesis formulated from these facts obtained. The yields were,

	Large.	Small.	Rotten.
C. 8. Eyes cut deep......	456 lbs. 4 ozs.	87 lbs. 13 ozs.	26 lbs. 2 ozs.
C. 9. Eyes cut half deep..	472 " 11 "	78 " 4 "	24 " 9 "
C. 10. Eyes cut shallow...	331 " 10 "	42 " 6 "	23 " 4 "

Or calculated per acre, we have,

	Large.	Small.	Rotten.	Total.
C. 8...........	152.1 bush.	29.3 bush.	8.7 bush.	190.1 bush.
C. 9...........	157.5 "	26.1 "	8.2 "	191.8 "
C. 10...........	110.5 "	14.1 "	7.8 "	132.4 "

The variations between the half plats were in per cent of crop;

	For good potatoes.	For total yield.
C. 8................................	14 per cent.	15 per cent.
C. 9................................	22 "	18 "
C. 10................................	10 "	12 "

As the variation between C. eight and C. nine is less than the variation between the half plats of each, the two must be considered as duplicates, and as indicating no difference between deeply cut and half-deep cut seed. The difference between C. eight and nine and C. ten is plus twenty-eight per cent greater than between the half plats, and hence it seems certain that the shallow cut eyes yielded inferior crop.

In order to afford a crucial test, whether the direction of cut had any influence upon the yield of single eyes, we planted C. three with eyes cut in the direction of the stem end, and C. four with eyes cut toward the seed end. The yields were as follows:

	Large.	Small.	Rotten.
C. 3, cut toward stem,	521 lbs. 12 ozs.	98 lbs. 2 ozs.	197 lbs. 13 ozs.
C. 4, cut reversed....	569 " 3 "	108 " 12 "	164 " 2 "

Or calculated to the acre:

	Large.	Small.	Rotten.	Total.
C. 3..........	173.9 bush.	32.7 bush.	66.0 bush.	272.6 bush.
C. 4..........	189.7 "	36.2 "	54.7 "	280.6 "

The yields of the half-plats were:

		Good potatoes.	Total.
C. 3.	Right-hand half.	167.5 bush.	270.2 bush.
	Left-hand half	180.3 "	274.9 "
C. 4.	Right-hand half..................	186.6 "	282.3 "
	Left-hand half	192.8 "	279.0 "

As we observe that the variation in the yield of the half-plats is greater than between the plats, we can correctly interpret the results of the figures as duplicates, and can reason that the direction of cut in the seed did not influence the crop.

In the garden plats with many varieties, the result, as is to be seen in the report of the *Horticulturist*, was similar.

In our trial of early and late planting, the figures are strongly in favor of early planting. It is possible, however, that variety influence might apply here, and that with other varieties than the White Star the facts would not hold. In C. eleven, C. twelve and C. thirteen, no fertilizer was used, and the conditions were presumably equivalent in all, except the date of planting. The seed used was single eyes.

PLANTED.	Large.	Small.	Rotten.
C. 11, April 23	753 lbs. 9 ozs.	65 lbs. 5 ozs.	84 lbs. 6 ozs.
C. 12, May 24.........	575 " 0 "	58 " 3 "	65 " 6 "
C. 13, June 23........	238 " 2 "	71 " 0 "	40 " 7 "

Or calculated to the acre:

	Large.	Small.	Rotten.	Total.
C. 11.........	251.2 bush.	21.8 bush.	28.1 bush.	301.1 bush.
C. 12.........	191.6 "	19.4 "	21.8 "	232.8 "
C. 13.........	79.4 "	23.6 "	13.4 "	116.4 "

There exists quite a diversity of opinion among farmers as to the portion of potato to plant. It is a custom with many to cut off and reject the seed end, and the results of trials, oftentimes conflicting, are quite often given to the public as proving one theory or another. When these experiments, however, are carefully studied, it becomes evident that the terms of the problem do not admit of exact representation in figures, but should rather be expressed in terms of greater or less.

As a contribution toward experiments to determine whether one portion of the potato is more valuable for seed than another, we, this year, laid out plat C. five to be planted with single eyes, in order, as cut from the potato. The potatoes used, the White Star variety, furnished from nine to twenty-seven eyes apiece, and thirty potatoes furnished the eyes requisite for planting one-twentieth of an acre in drills three and a half feet apart, each seed being placed at one foot distance in the drill. At harvest time each potato was gathered in three portions, to be designated as the stem third, the central third, and the seed-end third.

The total number of eyes planted was five hundred and eighty-two, and of these sixteen from the stem-end, five from the center, and four from the seed-end failed to grow.

The total crop 388.77 pounds of good potatoes; 86.23 pounds of small potatoes, and 192.62 pounds which were rotten. By multiplying by twenty the yield per acre will be obtained. In order to get figures which can be readily compared, we calculate the yield per one hundred eyes, or one hundred hills, and this may be represented by the following tables:

	Number of potatoes per 100 hills from —			
Butt eyes	195 good,	290 small,	122 rotten	— total, 607
Center eyes	234 "	269 "	176 "	" 679
Seed-end eyes	229 "	256 "	147 "	" 632

	Yield, in pounds, per 100 eyes planted from —			
	Good, lbs.	Small, lbs.	Rotten, lbs.	Total lbs.
Butt eyes	62.18	15.48	26.81	104.47
Center eyes	72.88	15.23	43.05	131.16
Seed-end eyes	73.73	15.72	33.41	142.86

The four eyes from the extreme seed end of these same potatoes, calculated in like manner, yielded per hundred eyes, two hundred and thirteen good, two hundred and seventy-two small, one hundred and fifty rotten — total, six hundred and thirty-five potatoes, and the weights were 82.55 pounds of good, 20.33 pounds of small, and 40.32 pounds of rotten — total, 143.20 pounds.

The lesson taught from these tables is that there is certainly no inferiority of the seed end when used for seed. On the contrary, the figures not only absolutely, but relatively show a distinct advantage for the seed-end eyes in weight and crop while the figures do not show the same advantage in the number of good potatoes. That this relation is not an accidental one is made clear by the calculation of the yield of the four extreme eyes from the seed end, which give figures yet more favorable.

Indeed, the general summary of our experience with the potato, as heretofore represented, as well as the result of the present experiment, goes to show that the vitality of the eyes used as seed improves according to the position they occupy upon the potato toward the terminal position.

During the season of growth the plants from the central eyes showed slightly more vigor of growth than did those plants from the ends of the potato. This fact was, however, so little marked that it could only be observed by taking a comprehensive glance over the plat which showed a slight undulation from the, in general, greater size of the central plants of the potato.

The variety used was the White Star, and it will be noted that the amount of rot was quite excessive, and indeed this rot seems to bear but an accidental relation to the position of the eye used as seed. It was impossible to obtain the true weights of the potatoes yielded on account of the destruction of some by the rot, involving a loss of weight, but, so far as our judgment could determine, any changes made by the rot would not seem to invalidate the relations of the figures as given.

Perhaps the influence of the position of the eye upon the potato is best illustrated by the total yield from the one hundred hills, which, as we have seen, is one hundred and four pounds for the butts, one hundred and thirty-one pounds for the centers, and one hundred and forty-two pounds for the seed-end eyes. Allowing sixty pounds to the bushel, and expressing our results in bushels, allowing each hill to have grown, we have for the total yield, two hundred and six bushels for the butt eyes, two hundred and fifty-nine bushels for the center eyes, and two hundred and eighty-two bushels per acre for the seed-end eyes; or, for the yields of good potatoes from the several kinds of eye, one hundred and twenty-three bushels, one hundred and forty-four bushels, and one hundred and forty-six bushels of merchantable crop.

While one experiment hardly affords sufficient data for the purpose of generalization, yet an experiment as carefully conducted as this one, and with the method of planting, should possess some value as indicating the influence of position upon the seed-eyes used. Yet we must remember, however, that if we had used more or less of the eyes in our trial the results would not have figured, in all probability, relatively the same. We can, however, truthfully express the fact that in this experiment we have gained increase of crop from the eyes taken from the seed-end portion of the potato, and we may be justified in coming to the general conclusion that until further evidence is obtained the seed-ends, hitherto rejected by many, may be considered of equal value with that portion of the potato usually selected for planting.

The study of our last year's experiments with potatoes led us to formulate a hypothesis that for the best growth of the potato it was required to keep the tubers warm and dry, and the roots moist and cool.

Where the theoretical considerations were satisfied we gained a yield per hundred hills of one hundred and eighty-four pounds of merchantable tubers as against eighty-three pounds grown under ordinary ridge culture. The only way we could devise in practice to secure these theoretical conditions was by planting the potato on ridges and mulching the intervals. Our plat planted in this way yielded us ninety-two pounds per hundred hills planted. It became an object this year to verify our idea on a larger scale before we could feel justified in claiming correctness. Accordingly a number of parallel plats were so arranged that one-half received mulching in the intervals, without hoeing or other care during the season of growth, while the remaining half was grown under the ordinary methods. For this experiment we recognized, however, during the season of growth that the conditions were very unfavorable for success, as the prevailing wetness prevented the expected result of our procedure from taking place. During June, July and August there were thirty-four days during which more or less rain fell, amounting in the total to 10.59 inches. The resulting crops are tabulated in the table which follows, and these certainly seem to give a sufficient answer that under circumstances of a wet season mulching without cultivation is not beneficial to yield as compared to the ordinary care in growing without the mulch.

PLAT.		Yield good potatoes. Lbs.	Ozs.
C. 16	Mulched	474	14
C. 14	Not mulched	605	12
C. 17	Mulched	430	4
C. 15	Not mulched	467	13
2 B. 1	Mulched	290	0
	Not mulched	457	9
2 B. 2	Mulched	260	9
	Not mulched	444	2
2 B. 3	Mulched	370	0
	Not mulched	532	11
2 B. 4	Mulched	396	12
	Not mulched	622	11
2 B. 5	Mulched	317	12
	Not mulched	512	15

We thus see that with seven trials on areas of one-twentieth of an acre for each method that in no one case have the mulched plats yielded the larger crop, and in most cases very manifestly inferior crop. This experiment, however, we deem inconclusive, because, as we mentioned before, the season was such an unusual one with respect to the atmospheric moisture that at no time during the year were the conditions favorable for the trial, the ridges between the mulching being damp instead of being dry, as would have been the case under an ordinary season, and the weeds growing to a greater extent than was desirable.

In our tests for the proper distance of planting we used White Star potatoes as heretofore, and single eyes were placed one foot apart in drills twenty-two inches and forty-four inches distance. The yields were:

		Good	Small.	Rotten.
C. 14.	Drills 44 inches,	605 lbs. 12 ozs.	61 lbs. 11 ozs.	79 lbs. 12 ozs.
C. 15.	Drills 22 inches,	467 " 13 "	190 " 9 "	97 " 12 "
C. 16.	Drills 44 inches,	474 " 4 "	60 " 5 "	69 " 5 "
C. 17.	Drills 22 inches,	430 " 4 "	197 " 8 "	57 " 12 "

Calculating these results to acre, we have:

	Large.	Small.	Rotten.	Total.
C. 14	201.9 bush.	20.6 bush.	26.6 bush.	249.1 bush.
C. 15	155.9 "	63.5 "	32.6 "	252.0 "
C. 16	158.1 "	20.1 "	23.1 "	201.3 "
C. 17	143.4 "	65.8 "	19.2 "	228.4 "

It will be thus seen that the indications are that where single eyes are used for seed too close planting is no advantage upon soil in fair condition of fertility.

In studying the influence of fertilizer upon the potato crop we are hampered by the condition of the soil, which is far from uniform in

fertility or physical construction, as is evidenced more by the crops than to the eye. In Series C. we had plats variously fertilized last year, and we can group them as below.

	Fertilizer per acre. 1882.	Fertilizer per acre. 1883.	Yield per acre. Good.	Yield per acre. Total.
C. 3	800 lbs.	400 lbs.	173.9 bush.	272.6 bush.
C. 4	800 "	400 "	189.7 "	280.6 "
C. 8	400 "	400 "	152.1 "	190.1 "
C. 9	400 "	400 "	157.5 "	191.8 "
C. 14	400 "	800 "	201.9 "	249.1 "

We can also mass the crops of Series 1 B., and arrange these also with reference to the applied fertilizer.

	Fertilizer per acre. 1882.	Fertilizer per acre. 1883.	Yield per acre. Good.	Yield per acre. Total.
1 B. 1	None.	None.	147.8 bush.	247.1 bush.
1 B. 2	200 lbs.	"	160.5 "	245.4 "
1 B. 3	400 "	"	166.5 "	239.1 "
1 B. 4	800 "	"	183.4 "	260.0 "
1 B. 5	1,600 "	"	230.4 "	308.4 "

In C. three and C. four we have duplicates, as also in C. eight and C. nine, but more fertilizer applied the preceding year in the case of C. three and C. four.

In C. three and C. four the variation between the yields is 15.8 bushels, and yet the results must be considered as duplicates.

In C. eight and C. nine the variation is 5.4 bushels, and these results might also be considered as duplicates.

The average yield of C. three and C. four is 181.8 bushels; of C. eight and C. nine, 154.8 bushels, the difference, twenty-seven bushels.

Averaging the differences for the two series under comparison, we have 10.6 bushels, and hence we can say that the effect of the four hundred pounds of fertilizer applied the preceding year is apparently measured by twenty-seven bushels + or — ten and a half bushels, or somewhere between sixteen and a half and thirty-seven and a half bushels as probable extremes.

In plats C. eight and C. nine, and plat C. fourteen, we have conditions alike, except in four hundred pounds additional fertilizer applied the present year. Applying the same system of interpretation, we have 154.8 bushels as the yield of C. eight and C. nine, and 201.9 bushels as the yield of C. fourteen. The difference, forty-seven bushels plus or minus ten bushels, equals thirty-seven to fifty-seven bushels, the approximate measure of the effect of the fertilizer.

In Series 1. B. we have for the gain upon the plats variously fertilized the preceding year over the unfertilized plat, 12.7 bushels, 18.7 bushels, 35.6 bushels, 82.6 bushels, or apparent and uncorrected gain for the various quantities of fertilizer as below:

Fertilizer used in 1882.

1. B. 2	200 lbs.	produced,	gain over,	1. B. 1.	12.7	bush.
1. B. 3	200 "	"	"	1. B. 2.	6.0	"
1. B. 4	400 "	"	"	1. B. 3.	16.9	"
1. B. 5	800 "	"	"	1. B. 4.	47.0	"

In this example there is an evident gain according to the quantity of fertilizer applied, but as there were used three different styles of seed upon each plat, viz.: single eyes, ordinary cuts and whole potatoes, the correction for probable yield cannot be made without comparison, and hence we will only interpret in terms of greater or less. It will be observed, however, that the influence of the four hundred pounds additional fertilizer on 1. B. four gives results comparable with one of the reductions gained from the analysis of the effect of four hundred pounds additional fertilizer previously applied in the case of C. three and four.

In the use of fertilizer it must be always remembered that it is the fertilizer which is taken into the plant structure that affects the crop, and hence the availability of fertilizer consists in large measure as to whether it and the plant come into proper relations. Fertilizer applied without the range of the plant-roots can certainly be of little avail. As the potato plant has a deep-rooting habit it seems worthy of inquiry whether fertilizer applied deeply within the ground, or more superficially, would produce the greatest increase of crop.

Plat C. six, single eyes of White Star potatoes, was prepared for this inquiry. Four rows were trenched eight inches deep, and ten pounds of fertilizer strewed upon the bottom. The earth was then replaced, and the seed planted in ridges, as usual. Four other rows were trenched in like manner, the filling replaced, ten pounds of fertilizer sprinkled over the surface, and the potato seed planted in the usual manner. The yields were,

	Large.		Small.		Rotten.	
Fertilizer deep.........	312 lbs	11 ozs.	16 lbs.	3 ozs.	71 lbs.	12 ozs.
Fertilizer superficial....	300 "	.. "	28 "	5 "	58 "	4 "

Calculating to acre areas we have for the —

	Good.	Total yield.
Deep fertilizer plat............. ...	234.5 bush.	300.5 bush.
Shallow fertilizer plat	225.0 "	289.9 "

These results are certainly inconclusive as indicating a difference. From what we have before shown concerning the nearness of figures to which duplicates attained, it will be seen that the variation of nine bushels of good potatoes is scarcely sufficient to draw conclusions from, either for or against the system of fertilizing. Indeed the whole experiment tends to show that there was no difference at all to be ascribed to the fertilizer. The rows of the deeply fertilized tract yielded from seventy-one to eighty-two pounds to the row; from the superficially fertilized tract, from sixty-eight to seventy-seven pounds per row of large potatoes, and in like manner from ninety-one to one hundred and five pounds, and from thirty-eight to one hundred and three pounds for total yield, thus indicating a very close equivalency of soil and planting.

The summary for our potato experiments this year furnishes us with scarcely any positive conclusions. There are, however, a number of inferences which can be drawn with quite an assurance of certainty.

Single eyes used as seed yielded satisfactory crop per hill, and more uniform crop per hill than whole potatoes or ordinary cuts.

Single eyes yielded a smaller percentage of small potatoes than did ordinary cuts or whole potatoes used as seed.

Ordinary cuts, upon the whole, yielded more favorable results than whole potatoes, markedly so when the seed used is subtracted from the crop gained.

Single eyes cut deeply so as to contain some substance gave far superior yield to eyes cut shallow.

The small seed-end eyes gave results by no means inferior, but rather superior, to those gained from central and butt-end larger eyes.

Early planting showed far more favorably in crop than later planting, not alone in quality, but in total yield.

Too close planting diminished the yield of good potatoes, and increased the yield of small potatoes, by measure.

Fertilizer left over from last year's application exercised a marked influence upon the crop.

How to Cut Potatoes to Single Eyes.

On account of the great saving of seed from the use of single eyes, and the certainty that single eyes yield satisfactory crop, it seems desirable to offer directions by which such seed may be the most conveniently cut.

If a potato be examined closely, the eyes will be seen to be so arranged that a line drawn circling from eye to eye will form a spiral, as each eye is a little above and further around the side than the one next below it. If, now, the potato be taken in the left hand, the stem-end down, and kept in a perpendicular position, it is ready for cutting. Now take a knife, and placing the blade above the first eye, cut down to the stem, thus removing one eye; rotate the potato to the left until the second eye comes under the knife blade, and remove this eye in the same manner, the knife retaining the same slope as before, and so continue until the seed-end is reached. The seed-end eyes can be cut into separate eyes according to the plan which at the time seems most convenient.

This method was brought to the attention of the public in B. K. Bliss & Son's pamphlet, entitled "The Potato, How to Cultivate, 1882," and perhaps in previous editions. It has been adopted by many of our best potato growers, and has been found to give satisfaction. It is well worthy the attention of farmers to practice this method until familiarized with its convenience and great saving of seed.

The potato tuber is a swollen stem, bearing upon its surface eyes or buds, each of which occupies the axil of an abortive leaf.

The tubers are borne normally upon an underground stem, usually upon the extremity, but occasionally beaded along its course. These stems are often very short, at other times quite long, and in either case a variety characteristic. Since the general use of machinery for harvesting, those varieties which have short underground stems, and hence bear their tubers compactly in the hill, are, other things being equal, to be preferred.

These underground stems appear above the roots from the lower part of the stem, usually from the region lying close to the eye, but in

varieties having a wider range of origin. By close study these stems seem to be axillary, or else to appear from dormant eyes. In cases of monstrosity, when the tubers are borne upon the ærial stems, out of the ground, they are usually sessile, and occupy the axils of the leaves.

There is a tendency in the tuber in some varieties more than in others to appear above the ground during growth, and when this happens they not only sunburn, taking on a green bark appearance, but often the eyes start, furnishing an abnormal growth, dwarfed and ragged as compared with the proper growth of ripe "seed."

In the case of rot, the fungus appeared this year first upon the leaves, and in the case of the formation of ærial tubers, affected them from above downward, in order, as also those tubers which were exposed on the surface before reaching those buried in the soil.

The roots of the potato extend downward, and ramify but little laterally as compared with their deeper development.

The plant has lost in most varieties its habit of fruiting, although the blossom may abundantly appear. The cause seems to be in the non-development of pollen.

Varieties differ greatly in earliness, leafiness, hardiness and prolificacy. Under unfavorable conditions one variety may prosper where another fails. Some varieties appear more rot-resisting than others.

When exposed to conditions favorable to germination the seed-end eyes of the tuber have a tendency to develop first, or if the tuber be, in imagination, divided into two halves across its axis, the upper half will develop its eyes while the lower eyes remain dormant. When the eyes were removed from thirty potatoes, and planted in order as cut, nearly all the eyes grew, but out of one hundred and ninety-two butt third eyes sixteen failed, and out of one hundred and ninety-three central eyes five failed, and out of one hundred and ninety-seven seed-end eyes four failed, under conditions of out-of-door culture. In another experiment in the green-house, out of one hundred and twenty-six potatoes set in a warm place the eyes from the upper half alone grew in one hundred and twenty-one cases, upon the dividing line in five cases. When the eyes were planted in order as removed from five potatoes all but one butt-eye vegetated, and the twenty-nine eyes from the stem half gave at one date one hundred and forty-two inches in length of shoot, while the thirty-one seed-end eyes gave one hundred and ninety-six inches of total length of shoot.

Under circumstances of out-of-door culture, with thirty potatoes cut into single eyes and planted in order as cut, there was slightly more folige to the plants from the central eyes than from the terminal eyes.

In vegetation in the field, the shoots from whole potatoes used as seed were slower to start than were those from single eyes.

In five duplicates in one case, and two in another, the plants from whole potatoes used as seed ripened their foliage in advance of the single eyes. This trial on plats of one-tenth and one-twentieth of an acre.

In green-house trials, in warm soil, no absorption of the material of the seed potato was noticed in any case. We refer to the visible absorption. After weeks of growth the potato-seed eye retained its firmness and shape, and when disintegration took place it was from decay.

In out-of-door culture, in many cases, the seed used, if a whole potato, maintained its form and visible structure until harvest; if a cut potato, in many cases the disappearance during the season appeared to be from decay. In other instances, when large pieces were used for seed, hollows were formed, which were followed ultimately by a general softening and disappearance of the seed through decay. So far as we at present can determine, visible absorption of the seed-potato during the growth of the plant takes place in some cases and not in others, and is never very general.

The size of the potato stems and foliage seems to bear no relation to the kind of seed used. The stems from a small eye often equal in size or exceed those from a whole potato used as seed, yet the mass of the foliage seems always greater from the whole potato than from the single eye on account of the greater number of stems. A single eye often sends up more than one stem, and often sends up a stem more or less branched and having the appearance of numerous shoots on account of the branches originating below the surface of the ground.

On account of the varying vigor in varieties of the potato, single eyes from a variety of weak growth may fail in many cases to originate a plant, while from a more hardy variety the eyes may about all grow. This variety difference makes it difficult to generalize for directions for culture. A variety which forms its tubers closely to the stem will admit of closer planting than a variety whose tubers are borne at a distance; a variety whose tubers have a tendency to approach the surface during growth requires deeper planting and more hilling than another variety whose tubers remain under the surface; a variety with large foliage requires more space than one with small foliage; a little vigorous variety requires richer soil and a better physical condition of the soil than a more vigorous variety. It is also probable that some varieties admit of earlier planting for profit than other varieties.

CORN.

Influence of Seed.

In our trials of last year we were surprised to find that the tip kernels of a flint corn yielded more abundantly than did the central or butt kernels of the ear. It seemed important to verify these results, and hence five plats of one-tenth of an acre each were prepared, and three rows in each respectively were planted with kernels from the butt, central and tip position on the ear. The yield of the three rows of each kind of seeding in pounds of ear corn are given in the following table, the variety, Waushakum Flint, no fertilizer or manure applied, the planting May 17, the harvest October 20:

PLAT.	Yield of sound corn. From butt seed.	Central seed.	Tip seed.
1. A. 1	156 lbs. 2 ozs.	159 lbs. 13 ozs.	167 lbs. 1 oz.
1. A. 2	168 " 1 "	160 " 6½ "	160 " 2½ "
1. A. 3	160 " 2 "	159 " 12 "	173 " 10 "
1. A. 4	172 " 12 "	180 " 15 "	184 " 6 "
1. A. 5	182 " 11 "	172 " 8 "	175 " 5 "
Total	839 " 12 "	833 " 6½ "	860 " 8½ "

PLAT.	Yield of soft corn. From butt seed.		Central seed.		Tip seed.	
1. A. 1	18 lbs.	9 ozs.	20 lbs.	12 ozs.	22 lbs.	10½ ozs.
1. A. 2	20 "	12 "	15 "	13½ "	24 "	2½ "
1. A. 3	22 "	00 "	22 "	6 "	19 "	6 "
1. A. 4	16 "	9 "	13 "	14 "	15 "	3 "
1. A. 5	12 "	13 "	16 "	10 "	17 "	0 "
Total..........	90 "	11 "	89 "	7½ "	98 "	6 "

The yield per acre, calculating eighty pounds of ear corn to the bushel, was —

Butt seed yielded 62.98 bushels sound corn.

Central seed yielded 62.50 bushels sound corn.

Tip seed yielded 64.71 bushels sound corn.

We thus can conclude *prima facie,* that the kernels from one portion of the ear are as good as those from another, and that there is certainly no inferiority for the tip seed.

In these cases the seeds used were the five butt, five central and five tip kernels taken from the same ears.

We observe that in the five trials in every case the tip seed yielded larger crop than did the central seed, and in three cases more than did the butt seed.

These tenth-acre plats received different cultivation in the upper and lower portion, so we can secure additional evidence through the harvesting of each half separately. The figures were as below :

Upper half, not cultivated.

PLAT.	Butt seed.		Central seed.		Tip seed.	
1. A. 1..............	85 lbs.	7 ozs.	86 lbs.	1 oz.	89 lbs.	7 ozs.
1. A. 2..............	92 "	0 "	88 "	10½ ozs.	88 "	6½ "
1. A. 3.............	79 "	14 "	82 "	4 "	94 "	4 "
1. A. 4..............	93 "	8 "	95 "	9 "	94 "	10 "
1. A. 5....	88 "	1 "	86 "	1 "	88 "	4 "
Total	438 "	14 "	439 "	6½ "	454 "	15½ "

Lower half, cultivated.

PLAT.	Butt seed.		Central seed.		Tip seed.	
1. A. 1..............	70 lbs.	11 ozs.	73 lbs.	12 ozs.	77 lbs.	10 ozs.
1. A. 2..............	76 "	1 "	71 "	12 "	71 "	12 "
1. A. 3..............	80 "	4 "	77 "	8 "	79 "	6 "
1. A. 4..............	79 "	4 "	85 "	6 "	89 "	12 "
1. A. 5..............	94 "	10 "	86 "	7 "	87 "	1 "
Total	400 "	14 "	394 "	13 "	405 "	9 "

From this view we also derive the same conclusion as before, that the tip kernels of corn are in no wise inferior to other kernels for use as seed.

The tip kernels proved not less reliable for vegetation than did the

other kernels. The corn was planted May 17, and commenced to vegetate May 28. Of three thousand four hundered and twenty kernels of each planted, one thousand and thirty-one of the butt kernels, one thousand one hundred and fifty-four of the central kernels and one thousand two hundred and ninty-four of the tip kernels were out of the ground on May 29, and at the final count, June 8, two thousand seven hundred and fifteen, or seventy-nine per cent of the butt kernels, two thousand eight hundred and eighty-nine, or eighty-four per cent of the central kernels, and two thousand nine hundred and sixty-five, or eighty-six per cent of the tip kernels had formed plants.

Certainly the coincident results of two years' trials would seem to justify the recommendation on our part for farmers to use for seed all the kernels from well tipped ears of flint corn.

In experiments carried on in the garden with very many kinds of seed, it was found that the small kernels selected for their diminutive size from a normal ear, yielded plants and crops not only equal but curiously enough often superior to those grown from kernels of normal size. In one case where very small shrivelled kernels of Waushakum corn were collected from a tassel where abnormally borne, and used for seed, the crop was very superior in quality and yield, and every ear perfect in type. Sixteen seed yielded eighteen good ears from six to nine inches long, and four unmerchantable ears. So far as our observations at present extend, the small size of the tip kernels offers no objection for certainty of growth or yield, but the hybridization from plants from large seed, may possibly vitiate our trial.

CULTIVATION.

Curiously enough we have found no evidence in favor of cultivating corn, as distinct from the removal of weeds. It is more than probable, as indicated by the lysimeter observations, that in case of severe drought the cultivation would have been very beneficial through its agency in conserving moisture to the land. The season this year was a wet one. Rains were not only frequent, as may be seen from our table of rainfall, but the coolness of the temperature retarded evaporation, and thus saved water to the soil.

To fully understand our this year's figures, it is necessary to recall the fertilizer applied to these plats last year. One A. one received no fertilizer, one A. two, two hundred pounds superphosphate, one A. three, four hundred pounds, one A. four, eight hundred pounds, and one A. five, one thousand six hundred pounds. The tenth of an acre plats were treated as two, the upper half having the weeds removed by superficial hoeing, the lower half cultivated. The yields in 1882 were, calculated to the acre:

	Yield per acre of sound corn. Uncultivated half.	Cultivated half.
1 A. 1, no fertilizer	54.7 bush.	49.9 bush.
1 A. 2, 200 pounds of fertilizer	53.8 "	45.0 "
1 A. 3, 400 pounds of fertilizer	55.5 "	49.7 "
1 A. 4, 800 pounds of fertilizer	58.5 "	56.9 "
1 A. 5, 1,600 pounds of fertilizer	57.7 "	56.7 "
Average	56.0 "	51.6 "

These same plats were planted again with corn this year, no fertilizer being used. The variety, the Waushakum, and the seed equal quantities from the butt, central and tip portions of the ear. The yield calculated to the acre, on the basis of eighty pounds of ear corn to the bushel, was:

	Uncultivated half.	Cultivated half.
1 A. 1	65.1 bush.	55.1 bush.
1 A. 2	67.3 "	54.9 "
1 A. 3	64.1 "	59.3 "
1 A. 4	70.9 "	63.6 "
1 A. 5	65.6 "	67.0 "
Average	66.6 "	60.0 "

We observe, first, that as a seasonal or fertilizer influence the yield of all the plats are 10.6 bushels more this year for the uncultivated portion, and 8.4 bushels for the cultivated portion.

	Increase in crop, 1883, over 1882. Uncultivated half.	Cultivated half.
1 A. 1	10.4 bush.	5.2 bush.
1 A. 2	13.5 "	9.9 "
1 A. 3	8.6 "	9.6 "
1 A. 4	12.4 "	6.7 "
1 A. 5	7.9 "	10.3 "
Average	10.6 "	8.4 "

We notice also that we see no indication of especial fertilizer influence; thus, the extreme range of crop in 1882, the year the fertilizer was applied, was but 4.7 bushels per acre, and in 1882 but 6.8 bushels per acre for the uncultivated half-plats; and 11.9 bushels per acre in 1882, and 12.1 bushels per acre in 1883 for the cultivated half plats. The order of yield in 1882 and 1883 was as below.

Uncultivated Half.

1882. Fertilizer.	1882. Plat.	1882. Yield.	1882. Fertilized.	1883. Plat.	1883. Yield.
800 lbs...	1 A. 4	58.5 bush.	800 lbs...	1 A. 4	70.9 bush.
1,600 " ...	1 A. 5	57.7 "	200 " ...	1 A. 2	67.3 "
400 " ...	1 A. 3	55.5 "	1,600 " ...	1 A. 5	65.6 "
None......	1 A. 1	54.7 "	None......	1 A. 1	65.1 "
200 lbs...	1 A. 2	53.8 "	400 lbs...	1 A. 3	64.1 "

Cultivated Half.

Fertilizer.	1882. Plat.	Yield.	1882. Fertilizer.	1882. Plat.	Yield.
800 lbs...	1 A. 4	56.9 bush.	1,600 lbs...	1 A. 5	67.0 bush.
1,600 " ...	1 A. 5	56.7 "	800 " ...	1 A. 4	63.6 "
None......	1 A. 1	49.9 "	400 " ...	1 A. 3	59.3 "
400 lbs...	1 A. 3	49.7 "	None....	1 A. 1	55.1 "
200 " ...	1 A. 2	45.0 "	200 lbs...	1 A. 2	54.9 "

Although the influence of the fertilizer of last year cannot be estimated in this year's crop of corn, yet it is worthy of notice that in the case of the potatoes the influence of the previous application was very noticeable.

In plat four A. we had another trial of the effect of cultivation. This plat was also in corn last year, the upper half without fertilizer, the lower half with four hundred pounds of superphosphate per acre. As this plat was only in part occupied with crop, we can but estimate the yield per acre from the plants that grew at sixty-eight bushels for the unfertilized and eighty-three bushels for the fertilized plat. The yield in 1883; no fertilizer applied, the corn of the Waushakum variety, planted May 17, and harvested October 12.

	Plat yield.	Yield per acre.
The uncultivated half...............	223 lbs. 4½ ozs.,	or 55.8 bush.
The cultivated half................	209 " 6½ "	or 52.3 "

These results, be it observed, are in accordance with those derived from Series one A.

ROOT-PRUNING.

We find no evidence this year favorable to the breaking of the roots of corn in order to influence crop. In order to render the experiment as decisive as possible, the operation was carried forward with great severity, the roots being cut just before the heading of the plant by means of a lawn edger forced its whole depth into the ground at two inches from the plant, and on two sides. The effect was quickly seen in the cessation of growth, and the yellowing of the foliage, and the plants did not recover vigorous growth throughout the season. If excessive root-pruning of corn during growth be advisable in some soils, it certainly is not in the clay soil of the Station.

The yields were, for the twentieths acres:

		Sound corn.	Soft corn.
6 A............	Not root-pruned	227 lbs.	34 lbs.
"	Root-pruned	131 "	32 "
D. 11..........	Not root-pruned.............	229 "	46 "
D. 12..........	Root-pruned	157 "	52 "
11 A. 1.........	Not root-pruned.............	232 "	25 "
"	Root-pruned	265 "	46 "
11 A. 2........	Not root-pruned.............	232 "	26 "
"	Root-pruned	162 "	36 "
11 A. 3........	Not root-pruned.............	232 "	32 "
"	Root-pruned	142 "	37 "
11 A. 4........	Not root-pruned.............	222 "	33 "
"	Root-pruned	102 "	51 "
11 A. 5........	Not root-pruned.............	217 "	42 "
"	Root-pruned	102 "	49 "

EFFECT OF FERTILIZER.

In Series eleven A., we have data for studying the effect of fertilizer left over from last year. In 1882, these plats received fertilizer

as follows: Two A. one, two hundred pounds superphosphate, two A. two, four hundred pounds, two A. three, eight hundred pounds, and two A. four, sixteen hundred pounds. Two A. five received none. In 1883 no fertilizer was applied. The yield of sound corn from the not-root-pruned half for the two years is as below:

Plat.	Fertilizer in 1882.	Yield per acre. 1882.	Yield per acre. 1883.
II A. 5	None.	38.7 bush.	54.5 bush.
II A. 1	200 lbs.	47.3 "	58.2 "
II A. 2	400 "	48.7 "	58.4 "
II A. 3	800 "	48.7 "	58.0 "
II A. 4	1,600 "	50.7 "	55.7 "
Average	.....	46.8	56.9

We first note that there is about the same average increase of 10·1 bushels, as seen in Series one A., with a variation of twelve bushels per acre between the plats in 1882, and 3.9 bushels per acre in 1883, and the increase in neither case seems commensurate with the amount of fertilizer used.

It is quite probable that the seasonal influence in respect to the appropriation of fertilizer is very great, as also in its relations to cultivation, and hence there must exist such an uncertainty of a few seasons' results as to forbid generalization. Both 1882 and 1883 were seasons of less than usual temperature, and 1883 of more than the usual moisture in the soil. This seems a true explanation, as the potato, a plant for a cool season, showed influence of previous application of fertilizer.

Distance of Planting.

To determine the best distance for the planting of corn is very desirable. It seems certain, however, that distance must vary with the variety grown, and with the rainfall and general climatic conditions of the locality. In general, this question must be settled for a locality by local observations.

One of the difficulties which beset us here, as well as elsewhere, in plat experimentation, is the uncertainty which attends the interpretation of results. It is hence worth while to present a study of duplicates, before giving our figures, and if we fail of a conclusion, yet we may hope to acquire some information as to the limitations to close experiment which prevails in this class of work.

A series of plats, each of one-twentieth of an acre, were prepared and treated as duplicates, the fertilization being at the rate of four hundred pounds of superphosphate per acre. The D. series planted May 18, the E. series May 19. The variety Waushakum, six kernels in a hill, afterward thinned to four, and the hills forty-two by forty-four inches apart.

	Sound corn.	Soft corn.
D. 1	227 lbs. 3 ozs.	39 lbs. 6½ ozs.
D. 2	198 " 2½ "	50 " 11 "
D. 5	258 " 0½ "	56 " 12½ "
E. 10	195 " 15 "	62 " 15½ "
E. 12	188 " 14 "	68 " 2½ "

Calculating the yield of sound corn to the acre in bushels of eighty pounds of ear corn, we have —

	Yield per acre.
D. 1	56.8 bush.
D. 2	49.5 "
D. 5	64.5 "
E. 10	49.0 "
E. 12	47.2 "
Average	53.4 "

In order to understand these figures we must see whether the variation is greater or less between these separate plats than between the individual plats. Harvesting each plat in two portions, and calculating the yields per acre, we have —

	Right-hand half.	Left-hand half.
D. 1	55.4 bush.	58.2 bush.
D. 2	51.6 "	47.4 "
D. 5	65.2 "	63.8 "
E. 10	48.9 "	49.0 "
E. 12	53.1 "	41.3 "
Average	54.8 "	51.9 "

As the variations between the plats are greater than the variations between their half-plats, it seems evident that there is a difference of soil which prevents the plats being considered as duplicates, and D. one and D. two are no exception to this rule. If these plats be considered as four of half size, we have for yield from left to right, fifty-eight bushels, fifty-five bushels, forty-seven bushels, fifty-one bushels, which order of figures confirms our conclusions.

It is thus seen that we have no reliable data for interpreting the yields from corn planted at various distances, and that only when the variations are very large can we be justified in claiming a true difference to be ascribed to the planting, and this only in terms of greater or less.

In D. two we had hills 42 x 44 inches apart, in D. four hills 21 x 44 inches apart, and in D. three hills 44 x 84 inches apart. The yields were of sound corn —

SPACES.	Plat yield.	Bushels per acre.
42 x 44 in. D. 2	198 lbs. 2 1-2 ozs.	49.5 bush.
44 x 84 in. D. 3	123 " 4 "	30.8 "
21 x 44 in. D. 4	198 " 0 1-2 "	49.5 "

We see here no gain in crop through the closer planting, but less in crop from the distant planting.

What these figures mean I hardly know for D. six, a duplicate of D. two, except that pig weed was sown in the intervals on July 2, yielded two hundred and forty-seven pounds and three ounces of sound corn, or 61.8 bushels per acre, exceeding D. two by twelve bushels, D. one by five bushels. Unless we are prepared to assert that the gain over D. two was produced by the presence of weeds, we hardly should claim

hat the equivalence of crop between D. two and D. four was produced by the difference in planting.

We have for other trials upon twentieth acre plats :

		Yield sound corn.
E. 4.	Hills 2 x 2 feet, 4 kernels in a hill........	113 lbs. 15 1-2 ozs.
E. 5.	" 2 x 2 " 6 " "	46 " 2 "
E. 6.	Drills, 9 rows, 1 kernel each 3 in	17 " 4 1-2 "
E. 7.	" 9 " 1 " " 6 "	144 " 1 1-2 "
E. 1.	" 7 " 1 " " 12 "	163 " 6 "
E. 2.	" 9 " 2 " " 12 "	90 " 8 "
E. 3.	" 9 " 2 " " 24 "	152 " 0 1-2 "

If we calculate the number of hills per acre of four kernels each, we have for a table—

			Yield.
D. 3.	1700 hills per acre, or	6800 kernels............	30.8 bush.
E. 10.	3420 " "	13680 "	49.0 "
E. 12.	3420 " "	13680 "	47.2 "
D. 4.	6840 " "	27360 "	49.5 "
E. 4.	10880 " "	43520 "	28.5 "

So far as these trials indicate we may believe that three and one-half by three and one-half feet is the proper distance for the kind of corn we used, although D. four with half the distance gives equal results.

The maize plant is, however, a great evaporator of water, and in a dry season close planting may hence he very injurious. In order to illustrate this we bring together equivalent trials of 1882, a dry season, with those of 1883, a wet season :

	Yield per acre 1882.	1883.
Hills 2 x 2 feet, 4 kernels to a hill............	7 bush.	28.5 bush.
" 3 1-2 x 3 2-3 feet, 4 kernels to a hill	49.7 "	49.5 "

Taking kernels planted per acre, in very near equivalents, we have:

Kernels planted.	Yield per acre. 1882.	1883.
6800 to 6900..............................	19 bush.	30 bush.
13000 to 13600..............................	50 "	49 "
43000 to 43500..............................	5 "	28 "

Weeds.

The influence of weeds in the growing crop of corn seems productive of injury, not only from their use of the food supply of the soil which might otherwise be appropriated by the maize plant, but as well from the shading of the ground and the consequent lowering of temperatures. We had one plat, E. eleven, upon which the Waushakum corn was planted and left to shift for itself. The weeds soon covered the ground, and the corn attained but little growth, and appeared yellowish in foliage throughout the season. The yield of the

twentieth of an acre was no sound corn, and but nine pounds and a half ounce of soft corn. An adjoining row of corn, planted in the interval between this plat and the next, had weeds encroaching upon one side, while the other side of the row was kept hoed. This row seemed to differ but little in appearance from rows in the clean plats alongside, and the damage caused by so much of its root area being occupied by weeds seemed trifling. The same observation was made with the sorghum plant. If weeds did all their damage through the robbing of the soil, then but a small quantity of fertilizer would be required to maintain the soil in its condition as against the loss by the weeds; as, however, the application of fertilizer does not produce this effect, we must presume that the damage from weeds is from some other cause. When the coolness of the shaded soil, as compared with the exposed soil, is considered, we may well have it suggested to us that weeds damage much the corn crop through the keeping of the soil temperature below that proper for the best development of the plant.

Of one thing, however, we may feel sure. The abandonment of a crop to weeds is not only ruinous to the yield, but is as well wasteful of labor which thus becomes fruitless.

STOLEN CROPS.

We had three plats designed for the study of the influence upon the main crop of growing beans and pumpkins, but the nearly complete failure of the bean and pumpkin seed to form plants vitiated the experiment, and hence the three plats may be considered as duplicates. Plat D. eight, planted with Waushakum corn and beans, yielded but four pounds eight ounces of beans, and D. ten, corn and pumpkins, yielded but twenty-eight pounds of pumpkin. The yield of corn was:

	Sound corn.	Soft corn.
D. 8	188 lbs. 8 ozs.	47 lbs. 13½ ozs.
D. 9	161 " 14 "	58 " 4 "
D. 10	119 " 1½ "	87 " 7½ "

The figures calculated to the acre read for the sound corn:

D. 8	47.1 bush.
D. 9	40.4 "
D. 10	29.8 "

While we can hardly suppose that the few pumpkin vines that grew were productive of great injury, yet we find a great falling off of crop upon the pumpkin plat, and a greater variation than occurs between other duplicates. We cannot believe that the presence of the beans added to the corn crop, but must rather believe the difference between D. eight and D. nine falls within the limit of variation incident to the system of plat experimentation.

DEPTH OF PLANTING.

On May 18 we planted one row each of Waushakum corn at different depths. Thirty-eight hills in a row, and six kernels in a hill, or two hundred and twenty-eight kernels in all. The vegetations were as below:

Number found Growing at Dates.

DEPTH.	May 29.	May 31.	June 1.	June 5.	June 22.
One-fourth of an inch..........	69	139	151	146	130
One inch....................	53	143	160	175	149
Two inches..................	1	71	117	160	148
Three inches................	0	15	27	117	135
Four inches.................	0	2	2	43	95
Five inches.................	0	0	1	15	91
Six inches..................	0	0	1	4	47
Seven inches................	0	0	4	11	26
Eight inches................	0	0	3	9	36

The loss in the plants was mainly occasioned by the heavy rain of June 18. In general, however, our counting of vegetations shows that all the seeds that vegetate do not form plants for crop. The losses come in cases from defective vitality, in cases from insect ravages, but mostly the former; exceptionally, as in our present case, heavy rains wash the soil, and uncover or earth over the young plants.

These rows were harvested October 12, and yielded of ear corn —

ROW.	Depth planted.	Sound corn.		Soft corn.	
1.......	1-4 inch deep.....	46 lbs.	1 1-2 ozs.	12 lbs.	6 ozs.
2.......	1 "	50 "	9 "	12 "	13 "
3.......	2 "	55 "	14 1-2 "	9 "	9 "
4.......	3 "	50 "	0 "	8 "	3 "
5.......	4 "	34 "	2 "	6 "	7 "
6.......	5 "	39 "	13 "	8 "	11 "
7.......	6 "	24 "	14 1-2 "	8 "	10 1-2 "
8.......	7 "	16 "	6 1-2 "	8 "	12 "
9.......	8 "	15 "	4 "	8 "	7 1-2 "

As the number of stalks varied greatly in the different rows, we will calculate the yield per one hundred stalks in pounds of ear corn.

ROW.	Depth planted.	Sound corn.	Soft corn.
1..............	1-4 inch	35.4 lbs.	9.5 lbs.
2..............	1 "	33.5 "	8.6 "
3..............	2 inches	37.7 "	6.5 "
4..............	3 "	37.0 "	6.0 "
5..............	4 "	35.9 "	6.8 "
6..............	5 "	43.7 "	9.5 "
7..............	6 "	52.9 "	18.4 "
8..............	7 "	63.1 "	33.6 "
9..............	8 "	42.3 "	23.5 "

It is thus seen that the great loss from deeply planting corn came from the loss of plants, and not so much from the unfruitfulness of the plants. It will, however, be noted that where few plants grew these plants had a larger area of soil for occupancy, and better conditions for growth.

Vegetation of Corn.

The seed, Waushakum corn, used was of high germinative quality. Tests showed that one hundred per cent grew under conditions of the

germinative apparatus. In order to observe the per cent that escaped the perils of the soil and other conditions, we counted the kernels planted, and those which formed plants for crop, upon plats E. six and E. seven. In E. six we had two thousand three hundred and seventy-six kernels, in drills; of these two thousand and nineteen grew, or eighty-five per cent. In E. seven we had one thousand one hundred and eighty-eight kernels planted; of these one thousand and six grew, or eighty-four per cent.

Calculating the variations in the number that grew in the nine rows, we find for E. six, a variation between the greatest and least vegetation per row of twenty-seven per cent; in E. seven, of eighteen per cent.

In E. six we had two hundred and sixty-four kernels planted per row. The greatest number which formed plants for crop was two hundred and forty-three or ninety-two per cent; the least one hundred and eighty-one, or sixty-eight per cent.

In E. seven, we had one hundred and thirty-two kernels planted per row. The largest vegetation in a row was one hundred and twenty-two, or ninety-two per cent; the least one hundred and one, or seventy-six per cent.

WHEAT.

Through the extensive winter-killing of the wheat upon our plats, and as also in the varieties planted, we must call our wheat trials of this year a failure. The quality of the small crop we obtained was very poor, the kernels being shriveled and of light weight.

Last year the Station secured twelve carefully selected samples of wheat of various and mostly unknown kinds, for the purpose of endeavoring to obtain a new seed wheat. Eight of the twelve samples included kernels in the head, while four of the samples were of threshed wheat. The wheat obtained was of very superior appearance, both in the head and in the development of the kernel. These samples were planted, one kernel in a place, at one foot intervals, at various dates, as received and we have to note some curious facts, as may be further studied in a table which will be given further on. Number two is the Black-bearded Centennial variety; number three heads of Clawson; number ten the premium wheat at the New York State Fair of 1882. The other samples are unknown varieties. We must first call attention to the small number of kernels which vegetated, varying from twenty-seven to ninety-eight per cent, the average being fifty-three per cent. If, then, but fifty-three per cent of the seed vegetated under the careful conditions of an experimental plat, we may assume that last season there must have been a far greater loss in actual field culture, and we therefore have a seeming explanation of the discrepancy that often appears between the quantities of seed recommended by experience, and that quantity which is often recommended by theoretical considerations. We can further see that heavy seeding may, in some seasons, result in thin seeding in effect.

By counting the plants at date, we obtain the per cent of the plants that survived the winter, and we find here a variation from seven to ninety-five per cent, the average being fifty-four per cent. This is equivalent to saying that upon our experimental plat, under exceptional care, but about one-fourth of the seeding became available for crop.

An inspection of the table will also show that under the conditions of the last season late planting was not only advantageous to the vegetation of the plants, but also to the winter survival.

We will also call attention to the fact that the much-vaunted Black Bearded Centennial wheat gave the smallest percentage of vegetation and the smallest number that survived the winter, and in our last year's trial as a spring wheat we also met with failure.

Numbers eleven and twelve, and four and five, are duplicates of two varieties, but we are unable to assign the duplicates to their proper numbers. If, as we suspect, number four and number eleven are duplicates, as also number five and number twelve, we note that thirty-three per cent of the early planted number four, and seventy-two per cent of the late planted number eleven vegetated, while forty-seven per cent of the early planted number five, and ninety-eight per cent of the late planted number twelve, vegetated. In survivals we note seventy-five per cent of the early-planted number four, and ninety-five per cent of the late planted number eleven, sixty per cent of the early planted number five, and eighty-two per cent of the late planted number twelve. We also note on averages that of the seven samples planted September 19, forty-five per cent survived. Of the three samples planted September 23–30th, forty-seven per cent survived, and of the two samples planted October 3, eighty-seven per cent survived.

TABLE.

No. Planted.	No. kernels planted.	Vegetated last fall.	Plants survived winter.	Per cent vegetated	Per cent of vegetated which survived.
1. September 19	132	41	30	31	73
2. " 19	158	43	3	27	7
3. " 19	114	43	11	37	25
4. " 19	36	12	9	33	75
5. " 19	47	22	13	47	60
6. " 19	47	23	16	49	70
7. " 19	28	15	8	53	53
8. " 23	114	87	24	76	28
9. " 27	114	76	22	66	29
10. " 30	116	84	71	72	84
11. October 3	58	42	40	72	95
12. " 3	58	57	47	98	82

BARLEY.

April 23 and 24 a number of varieties of barley were planted, in order to study the prolificacy under equivalent conditions. The drills or rows were two feet apart, thirty-three feet long, and about twelve kernels planted per foot.

The yield per row was as below :

VARIETY.	Pounds of screened grain.
Kinver's Chevalier	3.31 lbs.
Four-rowed	1.25 "
Manshury	2.06 "
Naked or Hulless	1.47 "
Two-rowed	2.25 "

The barley on a series of these rows was root pruned just before heading, one row having the roots cut with a spade along one side, and another row along both sides, which we shall designate as half-root-pruned and root-pruned in the table which follows:

	Yield per row. No cultivation, lbs.	Half-root pruned, lbs.	Root pruned. lbs.
Black Hulless	....	1.69	1.19
Chevalier	....	2.06	2 25
Kinver's Chevalier	3.31	3.25	3.00
Four-rowed	1.25	2.19	2.06
Manshury	2.06	1.44	1.44
Naked or Hulless	1.47	1.50	1.56
Sibley Imperial	....	2.19	2.12
Two-rowed	2.25	2.37	2.12

The influence of the excessive cultivation is thus seen to be detrimental in some cases, and advantageous in others, if it is proper to interpret these, in general, small differences as having a meaning. If we take those with full records, we find the crop for five rows of the uncultivated to be 10.34 lbs., of the five corresponding rows half-root-pruned 10.75 lbs., and of the five corresponding rows root-pruned 10.18 lbs., the differences being too slight to have meaning. Between the crops from the eight rows half-root-pruned and the eight rows root-pruned, the difference is 0.95 lbs,, scarcely sufficient to justify the conclusion that excess of root interference diminished the crop.

The only conclusion to be drawn from this experiment is, that the experiment itself is inconclusive.

We may, however, infer that varieties differ in prolificacy, and that which variety we use for seeding is of consequence.

FORAGE CROPS.

Maize seems the established plant for forage purposes. The variety planted at the station was the Southern White, and the seed in general germinated well. The areas, one-twentieth of an acre; the fertilizer used, four hundred pounds phosphate per acre, broadcast; the planting four kernels to the foot. Planted May 30, vegetated June 7, harvested the last of September. D. seventeen, E. eighteen and E. eight, designed as duplicates:

	Yield per plat.	Calculated per acre
D. 17	1761 lbs.	17.61 tons.
E. 18	1489 "	14.89 "
E. 8	1553 "	15.53 "

In plats D. eighteen and E. seventeen we planted Early Amber sorghum for comparison of yield with corn, four kernels to the foot. The yield was:

	Yield per plat.	Calculated per acre.
D. 18	1131 lbs.	11.31 tons.
E. 17	1133 "	11.33 "

The comparison between the maize and the sorghum is between equal plantings; the sorghum, however, germinated poorly, while the maize germinated well. Through oversight the missing seed were not counted. We hence have a comparison extremely unfavorable to the sorghum, even under the assumed circumstance. Indeed, sorghum for fodder will do better when planted far more thickly in the row than corn.

The analyses of these forage plants gave the following results :

	Whole plant.	
	Southern White Corn	Early Amber Sorghum
Water	81.46	75.04
Ash	1.16	.69
Albuminoid (N.x 6.25)	1.02	1.03
Crude fiber	5.93	5.81
Nit.-free extract	9.73	17.03
Fat (ether extract)	.70	.40
	100.00	100.00

If we calculate the yield of albuminoid per acre, we have 326.6 pounds per acre in the corn crop, and 233.2 pounds for the sorghum.

In plat E. nine corn and sorghum were planted together, three kernels of corn and six kernels of sorghum, in hills forty-two by forty-four inches apart. The germinations were poor. While one thousand and twenty-six kernels of corn were planted, but seven hundred and seventy-five grew; of two thousand and fifty-two kernels of sorghum, but one thousand six hundred and twenty-one grew. The yield was, actual, one thousand pounds corn, two hundred and forty-seven pounds sorghum forage. Total per acre, 12.47 tons corn and sorghum forage.

Calculating the missing hills on the same ratio of yield, we may figure one thousand three hundred and twenty-three pounds corn fodder, and three hundred and twelve pounds of sorghum forage, total one thousand six hundred and thirty-five pounds, certainly not a bad showing for a meslin crop, but through the circumstances of the season far from satisfactory as an experiment.

In plat E. thirteen we had trial of the Soja bean, planted May 18, in drills forty-four inches apart, four beans to the foot, except in two of the nine rows, from lack of seed. The yield of dried forage was two hundred and eighty-six pounds, or 2.86 tons of Soja hay per acre.

The analysis of the Soja bean, whole plant, as gathered September 26, the beans formed, but in the milk was as below :

	Fresh state.	Dry.
Water	70.41	....
Ash	2.58	8.71
Albuminoid (N.x 6.25)	2.20	7.44
Crude fiber	7.93	26.80
Nitrogen-free extract	16.01	54.11
Fat (ether extract)	.87	2.94
	100.00	100.00

Allowing the air-dry crop to contain twenty per cent of moisture, the yield per acre of dry substance was four thousand five hundred and seventy-six pounds, containing 7.44 per cent, or three hundred and forty pounds of albuminoid. The largest yield of fodder corn here reported contained but three hundred and fifty-nine pounds. The Soja bean, therefore, yielded nearly as much in chemically nutritive value as did maize. There is much woody matter, however, in the Soja bean plant, and experiments in feeding must determine its actual value.

The season was so cold and unfavorable that the cow peas did not fulfill the expectation raised by last year's trial. As far as this year is concerned, these beans offer no inducements toward their general use for forage purposes. A warm summer would, perhaps, however, develop a different judgment.

SUNFLOWER.

From a late article in the *Drug Reporter* we obtain some statistics relating to the growing of the sunflower as a crop. In Italy its cultivation is confined to the neighborhood of Piove and Conegliano, in Venetia; in Russia the plant is most extensively grown in Kielce and Podolia, and the district of Birutch in Voronej; the production of seed is now estimated at 288,000,000 pounds from an area of 216,000 acres, or about 1,325 pounds to the acre. In Tartary and China it is cultivated in immense quantities, but no actual statistics are available. In Mysore, India, one acre of land gives 1,288 pounds of seed, which yields forty-five gallons of oil, which is there compared to peanut oil, and applied to the same use. The Russian seed is expressed on the spot, and the oil is largely employed for adulterating olive oil. The purified oil is considered equal to olive and almond oil for table use.

The chief industrial uses of the oil are woolen dressing, lighting, and candle and soap making; for the last-mentioned purpose it is superior to most oils. It is pale yellow in color, thicker than hemp seed oil, and dries slowly.

Experimental culture in France gave a return of 1,778 pounds of seed, yielding fifteen per cent of oil and eighty per cent of cake from an acre; but the product varies considerably according to soil, climate and culivation, and the average may be roundly stated at fifty bushel of seed from an acre, and one gallon of oil from one bushel of seed. The percentage of oil to seed ranges from sixteen to twenty-eight, and that of husk to kernel from forty-one to sixty.

In Russia the seed is drilled into lines eighteen inches apart, and the plants are thinned out to thirty inches apart in the rows, thus giving about 11,000 plants to an acre. The quantity of seed required for an acre is forty-six pounds.

The station crop of 1883 occupied a plat of one-twentieth of an acre area, and was planted four kernels in a hill, the hills forty-two by forty-four inches apart, and was cultivated during growth the same as corn. The soil received at the rate of four hundred pounds of superphosphate to the acre. Planted May 18, vegetated May 31, harvested in September, and the seed beaten out and measured and weighed October 25, the yield being two and one-half bushels, or fifty-seven and and one-half pounds; expressed in acre yield, fifty bushels, or 1,150

pounds, the seed thus weighing twenty-three pounds per struck bushel.

From not having facilities at the station for expressing the oil, we must be content with the results of analysis. Dr. S. M. Babcock found the seed to contain 20.52 per cent of the oil in the air-dry seed. One hundred seed in air-dry condition weighed 187.7 grains, and contained 49.1 per cent of husk, and 50.9 per cent of kernel. The complete analysis is as below:

	Air dry.	Dried.
Water	12.68	.....
Ash	3.00	3.43
Albuminoid (N. x 6.25)	15.88	18.19
Crude fiber	29.21	33.45
Nitrogen-free extract	18.71	21.43
Fat (ether extract)	20.52	23.50
	100.00	100.00

The sunflower crop, however, has difficulties in the way of curing. As the plant ripens late in the season, the heads must be placed under cover to prevent waste, and they contain at this stage much water. We dried our crop by spreading the heads upon a floor, without piling, and as soon as the seeds were sufficiently dry they were shelled out.

As this has been a very late season, it is possible that in a more favorable year the seeds might be shelled off at the time of harvest.

Grasses.

Our grass plats are not, as yet, in order. Through the difficulty of obtaining pure seed of the varieties, it became necessary to sow such seed as we had in drills, and when the grass was in head and could be recognized, to weed out those plants not true to name. As we secure uniformity of variety to a plat, it is our intention to allow the drill intervals to be occupied, and thus to acquire a sod. On account of the clayey character of the soil, this weeding can only be effected after a rain while the ground is soft.

The growing of grasses upon a small scale and without mixture affords insufficient data for the formation of an accurate judgment concerning values, and notes must be supplemented through the experience gained from watching the species as growing in nature and under cultivation. The crowding of grasses seems to diminish the tufting of those species which have a tendency thereto, but yet, as a matter of common observation, the non-tufting species of grasses have ever been more popular for the purpose of cultivation than those which form tussocks.

The value of grass for cultivation seems to depend upon the foliage and upon the roots. To secure the greatest economy, species of grasses that root within different areas of soil should be grown in common, especially for pasture use. The June grass is able to withstand severe drought on account of its deep-rooting habit. The timothy grass seems only to be grown successfully *by itself in rotation with wheat* upon our richer soils, as its roots occupy the same area as do the roots of the wheat plant. If a section be cut through rich, natural pasture, and

the plants growing thereon be studied, it will be found that many species of plants are crowding each other, and that through a kind of natural selection the plants are so arranged that the various areas of the soil are nearly equally filled with the various roots. To define the areas of soil occupied by the roots of the various species must receive the attention of observers before the proper mixture of grass seed for varied uses can be recommended. With this explanation we offer the following notes, using the names under which the grass seed was obtained.

Agrostis canina.— Brown Bent or Dogs Bent grass. Planted April 10, 1882. In bloom June 28, 1883; seeds ripe July 31. It seems to have no especial agricultural value.

Agrostis vulgaris.— Redtop. Planted April 10, 1882. In bloom June 29, 1883; seeds ripe July 31. This is a very valuable grass, much grown in the Eastern States, but has not done well upon our plats.

Aira caespitosa.— Planted April 18, 1883. Vegetated May 19. Does not offer promise of being of agricultural value.

Alopecurus pratensis.— Meadow Foxtail. Planted April 10, 1882, vegetated in twenty-two days, and was in bloom July 7. It grew with but moderate vigor. It survived the winter well, and gave the earliest growth of any of our grasses in 1883, on April 18, being ahead of the other varieties, and on May 4, a few bunches coming to head, but in bloom only on June 11. Seeds ripe June 29. Although tall and moderately leafy, it yet seems light in proportion to its bulk. It would seem to be a valuable grass for early pasture, while its aftermath being superior to its spring growth, recommends it still more highly.

Anthoxanthum Puelii.— Planted April 18, 1883. Vegetated May 11, in bloom July 20. A small grass resembling *A. odoratum*, and may perhaps find place in lawn mixtures, as it is of vigorous growth.

Avena elatior.— Tall Meadow Oat Grass. Sown April 10, 1882, in drills, vegetated in twenty-four days, headed June 28, and bloomed a few days later. The first year a rather coarse grass with scant foliage. After being cut the aftermath superior to the first growth. Survived the winter, and started medium early this spring. Its adaptations seem rather for use in pasture mixtures than as a cultivated grass.

Avena flavescens.— Yellow oat grass. Planted April 12, 1882, vegetated May 10, in bloom July 20. As planted in drills it offers little promise of value.

Bromus Schraderii.— Rescue Grass. Planted April 10, 1882, in drills, vegetated May 3, headed June 28, and seeds ripe July 29, when the seeds were gathered and the plant cut down to the ground August 20; a second growth, larger than the first of many other grasses. On September 4, headed for the second time, and the seeds ripened before winter. A coarse, vigorous grass, not prepossessing in appearance as compared with other grasses, but furnishing considerable fodder. It is an annual. In 1883 the plant was found re-seeded from the droppings of the late seeds, but the growth this year has been slow. It seems to possess but little usefulness in the presence of our better varieties of grasses. This year in head June 21, and seed ripe July 31.

Cynosurus cristatus.— Crested Dog's Tail. Planted April 18, 1883; vegetated May 17.

Dactylis glomerata.— Orchard Grass. This was sown April 10, 1882, and vegetated in twenty-two days. It grew vigorously and well

throughout the season, but did not bloom. It, however, showed strong evidence of its tufting habit. It survived the winter well, and started into an early and vigorous growth, being exceeded, however, in earliness, vigor and amount of early foliage by the Meadow Foxtail. It bloomed June 11, 1883. Its habit of growth seems to unfit it for use as a cultivated grass, while yet it possesses its adaptations, which would recommend it, as a mixture in pasture seeding. Its seed ripe July 10, or earlier.

Festuca elatior.— Tall Fescue Grass. Planted April 10, 1883, vegetated May 2, bloomed July 7, but a few heads growing, and no seed noted as ripening. This is a dense, vigorous, succulent grass, affording a vast quantity of short herbage the first year from seed. Its succulency retained well into the autumn, but a bunching habit to the stools. This first year indicating value as a pasture grass. It came through the winter well, and the second year's growth, but emphasizes our previous remarks. In 1883 it bloomed June 14, and seed ripe on July 10, or earlier.

Festuca ovina.— Sheeps Fescue. Planted April 18, 1883, vegetated May 15. The planting of 1882 showed the flower head on May 11, and in full head May 27, and seed ripe June 29. This grass is of a deep blue green, the blade folded. It may find place as a pasture grass.

Festuca ovina tenuifolia.— Planted April 18th, and vegetated May 27th. Smaller than the preceding, and of less vigorous growth.

Festuca pratensis.— Meadow fescue. Planted April 18th, 1883, vegetated May 10th, in bloom July 20th. The planting of last year was out of bloom on June 29th. An excellent appearing grass for pasture use.

Holcus lanatus.— Planted April 18th, 1883, vegetated May 15th.

Lolium pacyii.— A grass which last year was of great promise, but it nearly entirely winterkilled. On July 16, 1883, a few surviving stalks were in flower.

Lolium perenne, var. Devon Eaver.— Planted April 12th, 1883, vegetated May 4, and bloomed July 16. A dense growing grass, appearing eminently fitted for lawn or pasture use, but we cannot speak well of it until we know whether it will survive our winters.

Phalaris arundinacea.— Reed Canary-grass. Planted April 18th, 1883, vegetated May 19. Did poorly.

Phleum pratense.—Timothy. Planted April 30th, 1883, vegetated May 15th, bloomed July 20th to 31st.

Poa aquatica. —Planted April 18th, 1883, vegetated May 26th. Did poorly.

Poa memoralis.—Wood Meadow Grass. Planted April 18th, vegetated May 19th, in bloom July 20th. Last year's plantings were well started on April 18th, and out of bloom June 29th, the seeds ripening July 31st.

Poa pratensis. —June Grass. Kentucky blue grass. This, from last year's plantings, has spread more outside of its drills than any other grown here. It came to head May 27th, and seeds ripe about July 1st.

Poa trivialis. —Rough-stalked Meadow Grass. Our last year's plantings were in bloom July 20th, the seeds ripe July 31st. Ap-

pears to possess some desirable qualities for cultivation, in mixtures with other grasses.

Poa serotina. — Fowl Meadow Grass. Planted April 12th, 1883, vegetated May 8th.

The *Alfalfa* and *Lucerne* of last year's plantings commenced growth early, and was in feeding condition April 18th. On June 15th in bloom On May 11th, the Lucerne was at least double the growth of the Alfalfa. On June 29, the foliage of both the Alfalfa and Lucerne were attacked by a blight. On July 31, the seeds were ripe in the earlier pods. These plants grew well, and furnished abundant forage. If a whole field did as well as our plats, we certainly could recommend its use. While these two names are botanically but one plant, *medicago sativa,* yet we find a slight variety difference.

REPORT OF THE CHEMIST.

The work accomplished in the chemical laboratory of the station during the past year comprises the following analyses and examinations:

1. Food Analyses.— (*a.*) 49 analyses of fodder plants, feed, seeds, fruits, etc.
   (*b.*) 30 analyses of individual stalks of corn.
2. Milk.— (*a.*) 48 complete analyses of the mixed morning and evening milk from the four cows, during the feeding experiments, and determinations of the specific gravity, per cent of cream and solids of each milking of the same period.
   (*b.*) 5 miscellaneous analyses.
3. Sugar.— (*a.*) 9 estimations of sugar in the juice of corn stalks.
   (*b.*) 22 estimations of sugar in the juice of sorghum at different periods.
   (*c.*) Several determinations of sugar in fruits, etc.
4. Fertilizers.— 15 analyses of superphosphates, kainits and other substances used as fertilizers.
5. Soils, muck, etc.— 6 examinations.
6. Water.—(*a.*) Monthly examinations of the water from lysimeters.
   (*b.*) 8 analyses of drinking waters.
7. Ash.— 2 complete analyses of ash of tobacco leaves; 1 of ash of the corn plant and several partial analyses of the ash of other plants and products.

FOOD ANALYSES.

In the following table are presented the several food analyses made. A few, made during the previous year, that appeared in the last annual report, are repeated for purposes of comparison.

	Fresh Substance.						Dry Substance.						Remarks.
	Water.	Ash.	Albuminoids, N. x 6.25.	Crude fiber.	Nitrogen-free extract.	Ether extract.	Ash.	Albuminoids.	Crude fiber.	Nitrogen-free extract.	Ether extract.	Total nitrogen.	
Hays.													
1. Meadow hay	13.88	4.88	5.38	33.33	40.32	2.21	5.66	6.25	38.70	46.82	2.57	1.00	Mostly timothy but mixed with other grasses and many weeds.
2. Alfalfa	75.01	2.15	4 07	8.68	9.45	.64	8.61	16.31	34.72	37.77	2.59	2.61	From station garden, 1883.
3. Orchard grass	76.25	2.60	2.97	7.60	9.23	1.35	10.95	12.50	32.02	38.85	5.68	2.00	From station garden, 1883, aftermath.
Fodder Plants.													
4. Cow pea, whole plant	86.03	1.89	3.25	2.87	5.34	.62	13.60	23.37	20.58	38.00	4.45	3.74	Green eyed white variety. Aug. 14, 1882, No blossoms.
5. " "	82.10	1.77	3.00	4.09	8.46	.58	9.90	16.69	22.86	47.33	3.22	2.67	Green eyed white variety. Oct. 7, 1882, No blossoms.
6. Soja hispida, whole plant	69.35	2.36	3.94	8.91	14.39	1.05	7.71	12.75	29.06	47.05	3.43	2.04	Sept. 19, 1882. Beans soft.
7. " "	69.85	2.22	3.88	8.26	14.24	1.55	7.35	12.75	27.41	47.35	5.14	2.04	Oct. 7, 1882. Beans ripe.
8. " "	70.41	2.58	2.20	7.93	16.01	.87	8.71	7.44	26.80	54.11	2.94	1.19	Sept. 26, 1883. Beans just forming.
9. Amber cane, whole plant	75.04	.69	1.03	5.81	17.03	.40	2.77	4.13	23.26	68.22	1.62	.66	Sept. 29, 1883.
10. Husk corn, whole plant	81.97	.87	1.52	5.34	9.49	.81	4.81	8.44	29.63	52.67	4.45	1.35	Aug. 9, 1883.
11. " "	82.15	1.09	1.45	5.59	9.20	.52	6.12	8.13	31.32	51.55	2.88	1 30	Aug. 22, 1883.
12. Silo corn	81.46	1.16	1.02	5.93	9.73	.70	6.26	5.50	31.99	52.48	3.78	.88	Sept. 5, 1882. Sample taken when silo was filled.
13. "	80.00	1.10	1.21	6.49	10.71	.49	5.48	6.06	32.45	53.55	2.46	.97	Sample that hung in barn till Nov. 27, 1882. Water assumed as 80 per cent.
14. Ensilage	78.61	1.50	1.60	7.10	10.22	.97	6.99	7.50	33.20	47.78	4.53	1.20	Taken from silo Feb. 15, 1883.
15. "	82.35	1.05	.87	5.87	8.72	1.14	5.95	4.94	33.27	49 38	6.46	.79	Taken from silo March 29, 1883.

Weeds.													
16. Plantago lanceolata........	84.00	1.64	1.81	4.13	7.80	.62	10.28	11.31	25.80	48.73	3.88	1.81	Plants in bloom collected July 24,'83.
17. Plantago major.............	80.84	2.79	2.10	3.09	10.56	.62	14.58	10.94	16.11	55.18	3.24	1.75	" " "
18. Leucanthemum vulgaris...	80.64	2.15	1.98	5.09	9.05	1.09	11.13	10.25	26.29	46.69	5.64	1.64	Plants in bloom collected Aug. 4, '83.
19. Cirsium arvense...........	75.39	2.40	2.05	7.28	11.20	1.68	9.74	8.31	29.60	45.51	6.84	1.33	Plants in bloom collected Aug. 6, '83.
Seeds.													
20. Soja hispida	7.30	4.82	37.44	.....	.....	14.74	5.20	40.87	.....	.....	15.90	3.46	Crop of 1882.
21. Sunflower..................	12.68	3.00	15.88	29.21	18.71	20.52	3.43	18.19	33 45	21.43	23.50	2.91	Crop of 1883. Variety "Oscar Wilde."
22. Corn, hybridized kernels..	16.57	1.25	10.90	1.75	64.61	4.92	1.50	13.06	2.10	77.44	5.90	2.09	Flint kernels from ears grown from rice corn seed.
23. " " ..	16.10	1.70	12.22	2.33	58.73	8.92	2.03	14.56	2.78	70.00	10.63	2.33	Sweet kernels from same ears as ab.
24. " " ..	22.11	1.06	7.84	1.60	62.84	4.55	1.36	10.06	2.05	80.69	5.84	1.61	White flint kernels from ears grown from white seed.
25. " " ..	22.25	1.05	7.39	1.72	63.49	4.10	1.35	9.50	2.21	81.66	5.28	1.52	Yellow kernels from same ears as ab.
26. Corn, butt kernels..........	.....	.....	.....	.....	.....	.....	1.52	10.25	2.20	81.30	4.73	1.64	Waushakum corn, 1882.
27. Corn, central kernels.......	.....	.....	.....	.....	.....	.....	1.50	11.69	2.02	79.19	5.60	1.87	Waushakum corn, 1882. Same ears as above.
28. Corn, tip kernels	.....	.....	.....	.....	.....	.....	1.55	10.56	1.65	88.82	5.42	1.69	Waushakum corn, 1882. Same ears as above.
29. Corn, upper ear.............	10.66	1.21	10.77	1.16	71.02	5.18	1.35	12.06	1.30	79.49	5.80	1.93	Waushakum corn, 1882.
30. Corn, lower ear.......... ..	9.37	1.14	9.74	1.12	73.42	5.21	1.26	10.75	1.23	81.01	5.75	1.72	Waushakum corn, 1882. Same stalk as the last.
31. Corn, upper ear.............	8.50	1.27	10.86	.67 (?)	74.00	4.70	1.39	11.87	.74 (?)	80.86	5.14	1.90	Waushakum corn, 1882.
32. Corn, lower ear.............	8.82	1.26	9.91	1.11	74.54	4.36	1.39	10.87	1.22	81.74	4.78	1.74	Waushakum corn, 1882. Same stalk as the last.
Feed.													
33. Corn meal..................	19.98	1.18	8.65	.50	65.35	4.34	1.47	10.81	.63	81.67	5.42	1.73	June 2, 1883.
34. "	18.44	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Feb. 10, 1883, from same ears as above.
35. "	12.84	1.15	7.52	.98	73.88	3.63	1.32	8.63	1.12	84.77	4.16	1.38	From whole kernels. Aug. 11, 1883.
36. "	13.05	1.09	7.66	.96	73.43	3.81	1.25	8.81	1.11	84.45	4.38	1.41	"New Process" from flinty portion of kernel, same corn as above.
37. "	12.53	1.26	7.11	1.68	73.96	3.46	1.43	8.13	1.92	84.56	3.96	1.30	"New Process" from that portion of the kernel containing and surrounding the germ. Same corn as above.
38. Wheat bran....	14.24	5.69	15.33	7.53	54.26	2.95	6.63	17.87	8.78	63.27	3.45	2.86	June 2, 1883.
39. "	14.13	5.26	14.64	7.87	55.24	2.85	6.12	17.06	9.16	64.34	3.32	2.73	June 11, 1883.
40. "	14.28	5.08	14.89	7.50	55.62	2.63	5.93	17.37	8.74	64.89	3.07	2.78	Feb. 10, 1883.
41. Gluten meal	7.31	.74	28.03	.73	54.46	8.73	.80	30.25	.79	58.74	9.42	4.84	Jan., 1883.
Vegetables.													
42. Onion, large red Wethersfield.	90.32	.42	1.04	.59	7.39	.24	4.30	10.75	6.10	76.36	2.49	1.72	Station crop, 1883.
43. Onion, yellow Danvers....	88.20	.48	1.14	.71	9.23	.24	4.03	9.69	6.03	78.18	2.07	1.55	" "
44. Top onion..................	81.53	.69	2.11	.74	14.69	.24	3.73	11.44	3.98	79.54	1.31	1.83	" "
45. Solanum tuberosum variety boreale..........	64.44	1.17	4.86	.78	28.62	.13	3.28	13.75	2.19	80.50	.38	2.20	" "
46. Sugar pea..................	81.80	.67	3.37	1.59	12.15	.42	3.69	18.50	8.73	66.77	2.31	2.96	Pod and seed in edible condition.
47. String beans	83.46	.83	2.75	2.58	10.04	.34	5.01	16.50	15.60	60.84	2.05	2.64	Early China variety, 1882.
48. Tomato, Acme.............	91.26	.73	1.00	.70	5.84	.47	8.32	11.25	8.03	67.05	5.35	1.80	Aug. 28, 1882.

FOOD ANALYSES — (*Continued.*)

	FRESH SUBSTANCE.						DRY SUBSTANCE.						Remarks.
	Water.	Ash.	Albuminoids, N. x 6.25.	Crude fiber.	Nitrogen-free extract.	Ether extract.	Ash.	Albuminoids.	Crude fiber.	Nitrogen-free extract.	Ether extract.	Total nitrogen.	
VEGETABLES (Continued).													
49. Tomato, Mayflower....	92.20	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Aug. 21, 1882.
50. " "	93.22	.....	.....	.....	.....	....	.....	.....	.....	.....	.....	.....	Aug. 31, 1882.
51. Tomato, Yellow Victor....	94 27	.....	.....	....	.....	....	9.14	.....	.....	.....	.....	2.32	Sept. 10, 1883.
52. Tomato, Blount's champion	94.41	.....	.....	.....	.....	....	7.88	.....	.....	.....	.....	1.92	Sept. 11, 1883.
53. " "	93.58	.....	.....	.....	.....	....	.....	.....	.....	.....	.....	.....	Sept. 19, 1883.
FRUITS.													
54. Apple, Tolman sweet	77.30	.46	.50	1.37	19.96	.41	2.05	2.19	6.02	87.92	1.82	.35	Crop of 1883. A poor sample.
55. Raspberry............... ..	85.82	.....	.....	.....	.....	.....	3.76	7.00	20.31	.....	.....	1.12	Highland Iardy, June 17, 1883.
56. Currant, black Naples	77.47	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Aug. 20, 1883.
57. Currant, Missouri sweet ...	78.90	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	" "
58. Huckleberry	81.76	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1883.

Analysis of individual stalks of the corn plant.

From a tenth acre plat of Waushakum corn thirty stalks, each bearing two ears, in as nearly the same state of development as could be determined by a superficial examination, were selected August 18, 1882, and a label affixed to each. The kernels of corn were just beginning to swell, showing that they had already been fertilized with pollen. Commencing at this date, and at intervals of one week thereafter, viz.: August 18, August 25, September 1, September 8, September 15 and September 23, five of these selected stalks were taken and analyzed separately, in the same manner. The analyses, not only gave a good average for the composition of the corn plant at each stage of development but are especially interesting, showing as they do the marked difference between individual stalks. The variation found between stalks of the same variety of corn grown under the same conditions of cultivation, soil and climate is almost as great as between different varieties grown in different parts of the country.

In each case duplicate determinations were made of the ash and nitrogen, the figures given being the mean, only one determination was made of the fat or of the crude fiber, unless there was reason for suspecting an error.

The result is presented in full.

CORN PLANT.	Fresh Substance. Height of stalk, feet.	Weight of stalk, grammes.	Water.	Ash.	Albuminoids.	Crude fiber.	Nitrogen-free extract.	Ether extract.	Dry Substance. Weight.	Ash.	Albuminoids.	Crude fiber.	Nitrogen-free extract.	Ether extract.	Total nitrogen.
August 18. Stalk 1	6.25	777.	87.32	.618	1.20	3.26	7.31	.294	98.5	4.87	9.81	25.70	57.30	2.33	1.57
" " 2	7.80	953.	86.11	.699	1.39	3.77	7.70	.326	132.4	5.03	10.06	27.14	55.42	2.35	1.61
" " 3	7.00	911.	85.12	.670	1.65	4.20	8.11	.332	135.5	4.50	11.19	28.24	53.84	2.23	1.79
" " 4	7.10	896.	85.91	.704	1.42	4.25	7.39	.330	126.2	5.00	10.12	30.15	52.39	2.34	1.62
" " 5	6.60	1014.	85.99	.618	1.44	3.64	8.01	.297	142.	4.41	10.31	25.97	57.19	2.12	1.65
Average	6.95	910.	86.05	.662	1.42	3.82	7.73	.316	126.9	4.76	10.30	27.44	55.23	2.27	1.65
August 25. Stalk 1	6.50	1265.	85.99	.702	1.71	3.91	7.42	.263	177.3	5.01	12.19	27.95	52.97	1.88	1.95
" " 2	6.75	847.	84.18	.748	1.73	4.48	8.54	.323	134.	4.73	10.94	28.32	53.97	2.04	1.75
" " 3	6.90	864.	82.60	.693	1.92	4.40	10.03	.357	150.3	3.96	11.06	25.31	57.60	2.05	1.77
" " 4	7.60	1032.	84.20	.667	1.61	4.44	8.79	.289	153.	4.22	10.19	28.09	55.67	1.83	1.63
" " 5	7.00	912.	84.94	.660	1.84	4.02	8.23	.312	137.	4.38	12.25	26.66	54.64	2.07	1.96
Average	6.95	984.	84.38	.694	1.76	4.25	8.61	.309	151.3	4.46	11.32	27.27	54.98	1.97	1.81
September 1. Stalk 1	6.90	986.	81.98	.777	1.88	4.68	10.33	.350	177.7	4.31	10.44	25.95	57.36	1.94	1.67
" " 2	5.75	684.	78.16	.954	2.39	4.88	13.15	.467	149.	4.37	10.94	22.34	60.21	2.14	1.75
" " 3	6.60	1325.	82.92	.859	2.06	3.43	10.39	.343	226.3	5.03	12.13	20.06	60.77	2.01	1.94
" " 4	7.50	1028.	84.53	.574	1.54	4.45	8.63	.277	159.	3.76	9.81	28.73	55.91	1.79	1.57
" " 5	7.80	1060.	81.48	.787	1.71	4.77	10.88	.374	196.3	4.25	9.25	25.74	58.74	2.02	1.48
Average	6.91	1017.	81.81	.790	1.92	4.44	10.68	.362	181.7	4.37	10.51	24.56	58.58	1.98	1.68
September 8. Stalk 1	7.33	988.	77.33	.859	2.17	4.91	14.27	.458	224.	3.79	9.56	21.67	62.96	2.02	1.53
" " 2	7.00	1185.	76.41	.870	2.23	4.61	15.25	.625	279.5	3.69	9.44	19.54	64.68	2.65	1.51
" " 3	7.00	1004.	77.14	.898	2.26	4.60	14.54	.568	229.5	3.98	9.94	20.14	63.55	2.44	1.59
" " 4	7.10	1182.	78.68	.874	2.03	3.96	13.97	.484	252.	4.10	9.50	18.55	65.58	2.27	1.52
" " 5	7.82	1016.	77.16	.884	2.81	4.38	14.61	.656	282.	3.87	10.13	19.19	63.94	2.87	1.62
Average	7.25	1075.	77.34	.877	2.20	4.49	14.53	.556	243.4	3.88	9.71	19.82	64.14	2.45	1.55

CORN PLANT.	Fresh Substance.								Dry Substance.						
	Height of stalk, feet.	Weight of stalk, grammes	Water.	Ash.	Albuminoids.	Crude fiber.	Nitrogen-free extract.	Ether extract.	Weight.	Ash.	Albuminoids.	Crude fiber.	Nitrogen-free extract.	Ether extract.	Total nitrogen.
September 15. Stalk 1	7.00	948.	74.15	.881	2.18	4.95	17.14	.698	245.	3.41	8.44	19.17	66.28	2.70	1.35
" " 2	7.00	742.5	74.28	.784	2.25	4.93	17.15	.610	191.	3.05	8.75	19.16	66.67	2.37	1.40
" " 3	6.25	811.	75.21	1.185	2.76	4.07	16.03	.749	201.	4.78	11.13	16.41	64.66	3.02	1 78
" " 4	7.42	977.	73.69	.905	2.53	5.35	16.80	.721	257.	3.44	9.63	20.35	63.84	2.74	1.54
" " 5	8.00	1282.	77.73	.719	2.13	4.69	14 25	.481	285.5	3.23	9.56	21.07	63 98	2.16	1.53
Average	7.13	952 1	75.01	.895	2.37	4.80	16.27	.652	235.9	3.58	9.50	19.25	65.07	2.60	1.52
September 23. Stalk 1	7.90	960.	68.91	.948	2 47	6.49	20.41	.768	298.5	3.05	7.94	20.88	65.66	2.47	1.27
" " 2	6 42	1134.	68.34	.934	2.91	5.44	21.37	1.008	359.	2.95	9.19	17.19	67 50	3.17	1.47
" " 3	7.33	1276.	69.04	.858	3.04	5.11	20.89	1.005	395.	2.77	9.81	16.49	67.68	3.25	1.57
" " 4	6.33	845.	67 93	1.023	2.98	8.15	18.96	.952	271.	3.19	9 81	25.42	59.11	2.97	1.49
" " 5	7.60	1208.	74.14	.768	2.20	5.39	16.76	.740	310.	2.97	8.50	20.85	64.82	2.86	1.38
Average	7.12	1084.	69.67	.906	2.72	6.12	19.69	.894	326.7	2.98	8.95	20.17	64.96	2.94	1 43

MILK.

Commencing January 2, and extending over a period of forty-seven days, daily examinations of the milk from four Jersey cows were made, for the purpose of ascertaining the influence of different rations on the quantity and quality of the milk. Determinations were made in the milk obtained at each milking of the specific gravity, per cent of cream and solids, and in the mixed morning and evening milk each day of fat, nitrogen, sugar and ash. The results obtained, together with the analyses of the rations fed, are given in another portion of this report, and will not be repeated here.

In the report of the station for 1882 is given an analysis of milk from fatigued cows. Hoping to find some explanation of the phenomenal richness of this milk the following experiment was tried: The morning's milk from one of the same cows was carefully analyzed, and throughout the day the cow's udder was subjected to continuous handling, with the intent of producing, as far as possible, the same mechanical effect upon the milk glands, as had been produced by the jarring of the car. The evening's milk was then analyzed in the same manner as the morning's had been.

Both analyses are given:

	Morning milk.	Evening milk
Specific gravity	1.0309	1.0303
Per cent of cream	17.00	12.00
Solids	14.41	12.74
Fat	5.22	4.05
Casein and albumen	3.86	3.67
Sugar	4.56	4.44
Ash	.74	.79

It will be seen that the effect of the experiment was to considerably diminish the solids. The real loss is no doubt more than is indicated above, as during all of our experiments, the solids in the evening's milk have been above one-half per cent higher than in the morning's milk. The loss falls principally upon the fat, although each of the constituents is slightly diminished.

In the milk from fatigued cows the solids were largely increased, the increase being wholly due to increased amount of fat, the other solids being less than above. More influence must be attributed to insufficient food and deprivation of water than to any mechanical effect of the journey. An analysis of the first milking after the cows arrived at the station is inserted here, and to facilitate comparison an analysis of milk from the same cows after they had become rested and accustomed to the place.

	Milk from fatigued cows.	Normal milk from same cows soon after.
Specific gravity	1.023	1.0306
Per cent of cream	30.30	14.00
Solids	18.73	14.54
Fat	10.50	5.40
Casein and albumen	3.53	3.61
Sugar	3.23	5.01
Ash	.59	.53

A cow was fed no food, except ensilage, for twenty-four hours, and at the end of that time, her milk was subjected to analysis with the object of determining whether the amount of lactic acid in the milk was increased by the ration. The fat in the dry solids was extracted, from one sample, with ether, and from another with pure carbon bisulphide. The amount of the ether extract would exceed that obtained with carbon bisulphide by the amount of free lactic acid present in the milk. The result given below shows that no appreciable amount was present:

	Solids.	Fat by ether.	Fat by carbon bisulphide.
Milk from cow fed on ensilage	15.16	5.53	5.50
Duplicate	15.22	5.55	5.57

Two analyses have been made of milk from Holstein cows belonging to the herd of G. S. Miller, Peterboro, N. Y. The milk reached us on the evening of May 22, and was stated to be a true sample from the morning's milking:

	Milk from Holstein cow "Nannie Smith."	Milk from Holstein cow "Gem."
Specific gravity	1.0319	1.0305
Solids	12.11	13.61
Fat	3.40	4.41
Casein and albumen	2.47	3.10
Sugar	5.69	5.34
Ash	.55	.76

The composition of the milk from the herd of four Jersey cows kept at the station as determined by analyses made during the feeding experiments is given below:

	Number of determinations.	Highest.	Lowest.	Average.
Specific gravity	94	1.0336	1.0296	1.0315
Cream	94	17.5	10	13.80
Solid	94	15.90	13.26	14.47
Fat	47	6.02	4.47	5.09
Casein	40	3.93	3.25	3.57
Sugar	40	5.56	4.64	5.15
Ash	47	.74	.56	.67

The variation between the morning's and evening's milk is shown in the following table which represents the average of all determinations made:

	Spec. grav.	Cream.	Solids.	Fat.
Morning	1.0320	12.74	14.20	4.83
Evening	1.0309	14.86	14.74	5.66

Sugar in Sorghum and Corn.

Eighteen named varieties of sorghum, the seed of which was grown at the station, and twenty-six varieties known only by number, the seed of which was furnished by Dr. Collier, were planted for the purpose of determining their adaptability to the climate of this section and their

relative value for the sugar industry. Only a few of the varieties reached a stage of maturity which warranted making any tests for sugar, and in only two or three did the seed advance beyond the milk. The Early Amber excelled all other varieties for sugar purposes, when habits of growth and proportion of juice obtained are considered, for while some others gave a larger percentage of available sugar in the juice, none would equal it in total amount from a given area.

In the following table are presented the results of examinations made:

SUGAR IN JUICE OF SORGHUM.

SORGHUM.	Date.	Average length of cane in feet.	Average weight of stalk, ounces.	Average weight of striped cane, ounces.	Per cent juice.	Specific gravity of juice.	Cane Sugar by polariscope.	Glucose.	Total Sugar.	Solids, not Sugar.	Available Sugar.	
Early Amber	October 4	9.	19.	15.	50.6	1.073	11.82	4.18	16.00	2.11	5.53	Seed in Milk
" "	" 15	8.75	18.	14.	47.8	1.072	12.00	3.64	15.64	2.12	6.24	" " Dough.
" "	" 23	9.	....	12.3	46.6	1.072	11.89	...	.....	....	...	" " " after severe frosts.
Niagara	September 22	7.5	.....	9.5	45.40	1.046	5.69	4.33	10.02	2.51	-1.15	" " "
"	" 22	7.75	.....	13.	48.10	1.052	7.54	4.86	12.40	1.39	1.89	" " "
"	October 4	8.5	15.	9.	52.6	1.060	8.13	4.	12.13	2.33	1.80	" hard
Miller	" 4	6.75	12.5	8.5	49.7	1.073	11.98	3.57	15.55	2.63	5.78	" "
"	" 15	6.5	13.5	9	49.1	1.070	10.79	3.58	14.37	2.36	4.85	" in Dough.
Iowa Redtop	" 5	9.5	17.	12.5	51.9	1.055	9.61	4.79	14.40	1.92	2.90	" " Milk.
Chinese Sorghum, No. 2	" 4	8.75	22.	13.	19.6	1.065	12.02	1.20	13.22	4.15	6.67	" " "
" " "	" 5	9.3	21.5	15.5	52.94	1.056	7.68	4.01	11.69	2.23	1.44	" " Dough.
" " "	" 16	8.5	....	8.5	20.	1.072	9.19	...	...	.	...	" " "
African	" 5	9.5	16.	10.5	43.1	1.068	8.31	4.26	12.57	2.85	1.20	" " "
No. 2	" 6	10.	14.	8.5	24.6	1.076	10.[illegible]0	1.71	12.22	4.72	4.08	" " Milk.
" 4	" 6	10.	13.	8.5	21.3	1.076	11.23	1.73	12.96	4.43	7.07	" " "
" 4	" 16	9.25	.	7.	17.2	1.074	10.43	...	...		....	" " Dough.
" 6	" 6	10.5	16.	11.5	23.1	1.074	10.88	2.04	12.92	4.02	6.06	" " Milk.
" 6	" 16	10.25	...	8.5	22.7	1.068	10.06	....	.....	....		" " "
" 24	" 5	9.	22.	17.5	48.4	1.076	12.79	3.36	16.15	2.73	6.70	" " "
" 24	" 15	9.	15.5	12.1	49	1.072	11.84	3.72	15.56	1.92	6.20	" " "
" 30	" 5	10.	12.	8.5	26.8	1.076	12.32	1.89	14.21	3.52	6.91	" " Dough.
" 30	" 16	10.	.....	13.	29.6	1.070	11.05	..	.....	....	....	" " "

One stalk of corn of the husked variety was tested for sugar September 7, with the unexpected showing of 10.2 per cent of cane sugar. This led to the belief that this might be a sugar plant, and numerous tests were afterward made to determine its value.

The juice was tested with the polariscope, the object being to find the relative amount of cane sugar in the stalks. The tests show a great variation running from one-half per cent to 10.2 per cent as mentioned above. Although the average amount of sugar found is not greater than was found last year in ordinary corn, or than was found in the experiments of Dr. Collier in Washington, the great variation between the stalks leads one to hope that by selection of seed a variety might be ultimately obtained sufficiently rich in sugar to be worked with profit.

The results obtained are given in tabular form below.

CANE SUGAR IN JUICE OF CORN STALKS.

VARIETY.	Specific gravity of juice.	Cane sugar in juice.	Date.
Husk corn	1.061	10.20	September 7, 1883.
"	1.042	3.51	September 7, 1883.
"	1.040	3.35	September 7, 1883.
"	1.042	6.46	September 7, 1883.
"	1.042	4.97	September 7, 1883.
"	1.020	.50	September 7, 1883.
"	1.044	5.82	September 24, 1883.
"	1.046	5.18	October 11, 1883.
Waushakum corn..........	1.024	1.90	September 11, 1883.
"	1.041	5.74	Average of determinations last year.

FERTILIZERS.

But few analyses of commercial fertilizers have been made and these few were undertaken not for the purpose of establishing a "Fertilizer Control," but for the accommodation of private parties. These analyses, ten in number, being of no public interest, are not given here.

In order to protect the Station from imposition directions for the sampling and sending of fertilizers for analyses have been issued and when these directions have been complied with, analyses have been made free of charge. A copy of these directions is appended.

CIRCULAR.

The following analyses of substances used as fertilizers are presented.

	Ash.	Nitrogen.	Potash K_2O.	Phosphoric acid P_2O_5.
Kainit	....	....	11.94	....
"	....	....	12.21	....
Leached ashes	....	....	2.08	1.18
Castor pomace	7.40	5.42	.96	1.70
Malt screenings	8.95	4.50	2.30	1.54

Analyses have also been made of a sample of ground Oakfield plaster and of ground shell marl. The sample of plaster is very pure, containing over ninety-nine per cent of hydrated calcium sulphate. The ground marl is essentially carbonate of lime.

	Water.	Insoluble matter.	Sulphuric anhydride SO_3.	Lime.	Volatile matter CO_2, etc.
Oakfield plaster	20.43	.36	46.19	32.39	.....
Shell marl	.....	5.50	.....	46.50	42.69

Three samples of swamp muck analyzed contain per cent:

	1.	2.	3.
Water	77.28	77.65	58.68
Organic and volatile matter	21.25	21.11	23.96
Ash	1.47	1.24	17.36
Nitrogen in dry substance	1.74	1.14	1.62

NEW YORK AGRICULTURAL EXPERIMENT STATION.

Instructions for sampling Commercial Fertilizers.

The Station is willing to undertake the analysis of commercial fertilizers (so far as its chemical facilities will admit) for the farmers of the State of New York, provided that the samples are sent in exact accordance with the following directions:

1st. Provide a tea cup, some large papers, and for each sample a glass fruit can, holding about one quart that can be tightly closed; all to be clean and dry.

2nd. Weigh separately at least three average packages of the fertilizer, and enter these actual weights in the form for description of sample.

3rd. Open the packages that have been weighed, and mix well together the contents of each down to at least half its depth, emptying out upon a clean floor, if needful, and crushing any soft, moist lumps in order to facilitate mixture, but leaving hard, dry lumps unbroken, so that the sample shall exhibit the texture and mechanical condition of the fertilizer.

4th. Take out five equal cupfuls from different parts of the mixed portion of each package. Pour them, fifteen in all, one over another upon the paper, intermix again thoroughly, but quickly, to avoid loss

or gain of moisture. Fill the bottle from this mixture, close tightly, labeled plainly, with a copy of the printing upon the bag or package, and send, charges prepaid, to the "New York Agricultural Experiment Station," Geneva, N. Y.

May 1, 1883.

BLANK FORM FOR DESCRIPTION OF SAMPLES.

Each sample of fertilizer sent for gratuitous analysis must be accompanied by one of these forms with the blanks filled out fully and legibly.

Brand of Fertilizer..

....

Name and address of manufacturer.................................

....

Name and address of dealer from whose stock this sample is taken...

....

Date of taking this sample...

Selling price per ton or hundred....................................

Actual weight of package opened...................................

Copy of all the printing upon the bag or package.

....

....

....

....

I hereby certify that in the presence of ....

..................................as witness I have taken the above described sample in accordance with the directions given, and that said sample, in my belief, represents fairly the average condition of the fertilizer as received.

Signature and P. O. Address.

....

Signature of witness.

....

NOTE.—When the expense of making an analysis and the importance of the published results for good or evil to the manufacturer is considered, the applicant for gratuitous analysis should certainly find no fault with the trouble employed in carrying out these directions which are considered essential.

WATER ANALYSIS.

Monthly determinations have been made of the amount of free ammonia and of nitric acid in the drainage water from the lysimeters, but as they are only preliminary to a more extended examination dur-

ing the coming year, a presentation of the results is deferred until a succeeding annual report.

Examinations have also been made of several samples of drinking water for private parties.

Ash Analysis.

Two complete analyses of ash from the leaves of tobacco have been made. No. 1 is from tobacco that had been fertilized with air-slaked lime. No. 2 from tobacco fertilized with sulphate of iron.

A careful analysis of ash from samples of thirty stalks of Waushakum corn, taken at different stages of development, is also given. The ash analyzed was from the whole plant.

	Tobacco, No. 1.	Tobacco, No. 2.	Corn.
Per cent of ash	20.27	21.87	.81
Potassa K_2O	26.15	24.76	34.36
Soda Na_2O	1.51	1.75	.50
Magnesia My O	5.20	5.15	11.64
Lime Ca O	28.26	28.23	10.76
Oxide of iron Fe_2O_3	1.10	1.42	1.28
Phosphoric anhydride P_2O_5	2.38	2.68	10.43
Sulphuric anhydride SO_3	5.44	5.43	2.60
Chlorine	.66	.74	2.93
Silica SiO_2	8.07	9.92	19.59
Carbon dioxide Co_2	20.83	20.84	5.76
Unconsumed carbon	.38	.41	....

Analytical Methods.

Although the methods of analysis adopted have been similar to those in general use by agricultural chemists, several modifications in the details of the work have been introduced which have greatly facilitated it. The following description of the methods and apparatus used is therefore given to enable others, who may wish, to test their value.

I. Fodder Analysis.

1. *The sample and water determination.*

For dry fodder, like hay, straw, cornstalks, etc., a quantity sufficient for a fair sample is cut with a fodder cutter, the cut portion thoroughly mixed and two or three pounds taken for the water determination. The sample is divided in two or more portions, placed in tared dishes, weighed on a balance sensitive to 0.1 gram, and dried at 100° C. till the weight is practically constant. The loss gives the water.

Green plants are dried directly at 100° C. as above, after being cut in suitable pieces with shears.

Prolonged drying at 100° C. is not desirable, for while it does not materially affect the quantity of water found, in some substances it induces a change in the fats, probably an oxidation, which makes them insoluble in ether. This is shown in the following determinations of fat in corn meal. The meal was first dried about thirty hours when it was found to be dry. The fat was determined in a por-

tion of this by exhausting with ether, and the remainder of the meal returned to the oven where it was left for several days when the fat was again determined. This experiment was repeated with the result given below:

TIME OF DRYING,	30 hours.	7 days.	30 days.	40 days.
Ether extract, I............	5.84	5.14	3.45	....
Ether extract, II............	5.87	....	3.21	1.80

This marked decrease is not due to a loss of fat, but to some change which renders it insoluble in ether. Fat extracted from corn meal becomes practically insoluble in ether after being dried several days at 100° C.

The dried substance is ground together in a common drug mill, the grinding being repeated till the sample is sufficiently fine for the several determinations, and is preserved in glass-stoppered bottles until wanted for further examination.

A quantity of this is again dried at 100° C. to remove the moisture absorbed while being ground, before taking portions for the remainder of the analysis.

2. *Ash.*

The ash is determined by burning about five grams of substance in a tared platinum dish at low redness. The burning is greatly facilitated by suspending a concave piece of platinum foil a short distance above the dish. This foil may be heated by an extra lamp from above if the burning proceeds slowly. Most substances, however, burn readily, to a nearly white ash, without heat from above. The crude ash obtained as above is what is represented in the analyses given in this report.

3. *Albuminoids. Total nitrogen.*

The crude albuminoids, only, obtained by multiplying the total nitrogen by 6.25 are considered in the fodder analyses.

The total nitrogen has, in all cases, been determined by Varrentrapp and Wills' method. The soda-lime used has been prepared by heating together equal parts of crystalized carbonate of soda and lime, as described by Prof. Johnson in the Connecticut Station Reports.

In *Fresenius' Zeitschrift für Analytische Chemie*, 1883, 3, appeared a new method for the estimation of nitrogen in organic substances by J. Kjeldahl. The method consists in treating 0.3 to 0.7 gram of substance, according to the amount of nitrogen that it contains, with 10 c.c. of concentrated sulphuric acid. The substance is weighed in a flask of about 100 c.c. capacity, the acid added and the mixture heated to nearly the boiling point of the acid till the substance is dissolved. This seldom takes more than two hours. The substance need be pulverized only so far as is necessary for obtaining a good sample. To the solution in sulphuric acid, while still hot, is added gradually dry potassium permanganate in fine powder, till the organic matter is completely oxidized. The reaction is very violent, flashes of light often appearing in the flask; there is, however, no danger of loss of nitrogen. The liquid becomes first colorless and transparent and finally green when the oxidation is completed. The nitrogen in or-

ganic substances is all transformed into ammonium sulphate by this treatment, and it only remains to distil the solution with excess of alkali and determine the ammonia in the distillate.

The green solution, after cooling, is diluted with water, when it changes to a brown color. It is then transferred to a flask of about three-quarter litre capacity, containing a few small pieces of zinc. The zinc causes a slight evolution of hydrogen during the distillation with alkali, and thus prevents bumping, which would otherwise be so violent as to render the method impracticable. Forty c.c. of a solution of caustic soda (sp. gr. 1·30) is added to the contents of the flask which is immediately connected with a condenser and rapidly distilled. The distillation proceeds quietly and is finished in ten to fifteen minutes. The distillate is received in a flask containing a known quantity of standard acid and is titrated with standard alkali.

The method is very economical of time, as many as twenty determinations being readily made in a day. The saving of combustion tubing and gas is also quite an item. The method seems to be accurate. Determinations made by the author in a great variety of substances gave results which agree very closely with those obtained by combustion with soda-lime. The author recommends the method for organic bodies in general, excepting only those in which the nitrogen occurs in the form of volatile acids. While it would be expected that nitric acid would be, in great part, expelled by heating with a large excess of concentrated sulphuric acid, he found that in the presence of organic matter the nitric acid was largely converted into ammonia.

Determinations made in the station laboratory of nitrogen in coarse fodders that had been previously analyzed by Varrentrapp and Will's method, fully confirm the conclusions of the author, and there is little doubt that it will prove a great aid to agricultural chemists. The results obtained by both methods are given below. The determinations with soda-lime were made six months before those with the new method. It is, therefore, probable that the difference in the two methods may be largely due to the sample examined.

	Soda-lime.	New method.
1	1.36	1.34
2	1.41	1.38
3	1.77	1.79
4	1.51	1.57
5	1.26	1.27
6	1.46	1.47
7	1.57	1.56
8	1.46	1.51
9	1.57	1.49
10	1.45	1.51
11	1.93	1.96
12	1.72	1.77
13	1.95	1.96
14	1.65	1.66

4. *Ether extract.*

A filter for obtaining the ether extract is made by blowing a small hole (three millimeters in diameter) in the bottom of a test tube, ten

centimeters long, and two centimeters in diameter. In the bottom of this tube is placed a small tuft of ignited asbestos, and over this is poured a little asbestos pulp. By means of an adapter and a filter pump the filter is washed repeatedly with water till the washings are clear, and is then thoroughly dried. Two or three grams of substance are weighed in the tube, which is placed in a fat extractor, similar to that described by Professor Caldwell in the second report of the Cornell University Experiment Station, and the substance exhausted with ether. The ether extract is dried at 100° C., and weighed in a tared flask.

A tuft of clean cotton is kept in the bottom of the fat extractor to arrest any loose fibers of asbestos that may escape from the filter. The extracts thus obtained have been uniformly clear.

5. *Crude fiber.*

The tube containing the fat-free substance, in the preceding section, is placed for a short time in the drying oven to remove the adhering ether. The substance, together with the asbestos composing the filter, is then transferred to a beaker of about 500 c.c. capacity, the small particles of substance adhering to the tube being washed into the beaker with a little water. Fifty c.c. of a five per cent solution of sulphuric acid and water enough to make the volume 200 c.c. are added to the contents of the beaker which is heated to boiling, and kept at that temperature for thirty minutes. Care must be taken to prevent the liquid boiling over when ebulition first begins; after the boiling has continued a short time it will proceed quietly.

While the boiling is in progress a filter is prepared by placing a tuft of ignited asbestos, supported by a small platinum cone, in the throat of a funnel of about 200 c.c. capacity, and pouring a little asbestos pulp over it.

The filter may be washed with water till no asbestos is separated, if desired, but this is not necessary as none of the substance will pass through, if the filter is properly prepared. When sufficiently boiled, the contents of the beaker are allowed to settle for a moment, and the liquid poured upon the filter, leaving the solid substance, as much as possible, in the beaker. The filtration is conducted without pressure as the substance often becomes so compact upon the filter when pressure is applied that it greatly hinders the flow of the liquid. The substance in the beaker is washed three or four times, by decantation, with hot water, pouring the liquid through the filter. The washing is greatly facilitated by the use of the filter pump. When washed the substance in the funnel together with the asbestos filter is returned to the beaker. Two and five-tenths grams of potassium hydrate, in solution, and water enough to make the volume 200 c.c are added, and the whole is then boiled for thirty minutes. After the boiling, with the alkali, has continued for a few moments there is a tendency to bump. The bumping is sometimes so severe that the boiling cannot be safely continued over the lamp, in such cases the beaker is removed to the steam bath, and kept at 100° C. till the expiration of the time. The contents of the beaker are then filtered through a "Gooch crucible," without the aid of the pump, washed with hot water, then with alcohol, and finally with ether. It is then thoroughly dried and weighed, after which it is ignited and weighed again. The difference between the two weights gives the crude fiber.

II. Milk.

The analyses of milk, made at the station, have included the following determinations :

1. Specific gravity.
2. Cream.
3. Solids.
4. Fat.
5. Albuminoids (casein and albumen).
6. Sugar.
7. Ash.

The milk to be examined is thoroughly mixed by pouring, several times, from one vessel to another before taking samples for analysis. The portions taken for the solids, fat, albuminoids and ash are weighed ; that taken for the sugar is measured. The milk may be weighed in a small dropping bottle, but more conveniently in a pipette with a bulb ten to twelve centimeters long, holding about fifteen c. c., with marks to indicate five c. c. and ten c. c. The stem of the pipette is a tube with thick walls and about one mm. bore. On the end of the stem is slipped a rubber tube containing a small glass ball that completely closes it and acts as a valve. By pinching the rubber tube at the side of the ball a channel is formed which admits the air and gives complete control of the flow of liquid from the pipette. The pipette is filled by attaching a short glass tube to the end of the rubber, opening the valve and applying suction in the usual way. When filled to the mark the pipette is wiped dry with filter-paper and the rubber tube moved sufficiently to withdraw the liquid from the point. The pipette and milk can then be weighed without danger of loss.

The analysis is conducted as follows :

1. *Specific gravity.*

The specific gravity may be most accurately determined with the pipette described above, by finding the weight of distilled water at 15° C., which the pipette holds when filled to the mark. The weight of milk which the pipette contains divided by the weight of water gives the specific gravity very accurately. Care must be taken to bring the temperature of the milk to 15° C. before weighing.

In the analyses given, the specific gravity has, in all cases, been taken with a delicate hydrometer, the scale of which admits of reading to ten-thousandths. The reading corrected for temperature gives results which are accurate to the third decimal.

2. *Cream.*

A glass cylinder 2.5 centimeters in diameter and about 20 centimeters high, graduated in cubic centimeters, is filled to the 100 c. c. mark with milk and set aside fifteen hours, the temperature being about 15° C. The number of divisions occupied by the cream is easily read off and gives the per cent by volume.

3. *Solids.*

About two grams of rather coarse asbestos are placed in a platinum evaporator of 30 c. c. capacity, ignited and weighed. Five c. c. of milk from the pipette, previously weighed, is run into the evaporator

and the pipette weighed again. The milk in the evaporator is then dried at 100° C. until the weights taken one-half hour apart do not vary more than a milligram from each other.

The asbestos serves as an absorbent of the milk, and presents a large surface which greatly facilitates the drying. For this purpose asbestos is much to be preferred to sand or any fine powder which requires frequent stirring for complete dessication. When a number of analyses are to be made in succession, a second portion of milk may be dried in the same asbestos with advantage. In the series of analyses made during the feeding experiments the morning's and evening's milk were dried together in this way. The dried residue may be ignited for ash (section 7).

The figures given for solids in all analyses made during the year have been determined in the above manner. The solids may, however, be found with equal accuracy and in much less time by the method given below.

In the bottom of a perforated test-tube, such as is used in the estimation of the fat in fodders, is placed a tuft of clean cotton. The tube is then filled three-quarters full of ignited asbestos and a plug of cotton inserted to prevent the escape of loose fibers of asbestos. The asbestos must be slightly pressed together so as to leave no large spaces. The tube and contents are weighed, the plug of cotton carefully removed and five grams of milk, from the weighed pipette, described before, run into it and the plug of cotton replaced. The tube, connected at its lower end by a rubber tube and adapter with a filter pump, is placed in a drying oven at 100° C. and a slow current of dry air drawn through it till the water is completely expelled, which in no case requires more than two hours.

The weights of tube and contents, in two instances, after drying different times, are given below.

Time dried.	1 hour.	1¼ hours.	1½ hours.	2 hours.
Weight of tube I....	15.8774	15.8646	15.8640	15.8637
Weight of tube II....	13.2868	....	13.2840	13.2840

The method gives accurate results as is shown by the following determinations made in this way and by drying in an evaporator with asbestos.

SOLIDS IN MILK.

	Dried in evaporator with asbestos.	Dried in asbestos with current of air.
1	14.93	14.88
2	14.62	14.58
3	15.31	15.35
4	15.47	15.51
5	14.18	14.15
6	14.84	14.81
7	13.96	13.94
8	15.23	15.25
9	13.61	13.61
10	14.66	14.70
Average of 96 determinations....	14.44	14.42

In general, determinations by the two methods have agreed as well with each other as would two determinations made by the usual method.

4. *Fat.*

The tube containing the solids from five grams of milk, obtained as in the preceding section, is placed in a fat extractor and exhausted with ether in the manner described in the analysis of fodders. The fat is dried at 100° C. and weighed. The ether solutions obtained in this way have all been clear. In more than a hundred determinations of fat in milk it has not been necessary to filter a single one before drying.

5. *Albuminoids — Casein and Albumen.*

The albuminoids and other constituents containing nitrogen have all been classed together under the head of casein. The numbers given are obtained by multiplying the total nitrogen by 6.33.

The total nitrogen is obtained from about five grams of milk. For this purpose the milk is weighed in the pipette, in the usual way, and run into an evaporator containing sufficient plaster of paris to absorb it. It is stirred for a few moments to prevent its hardening in lumps and placed for a short time in the drying oven. It is then pulverized in a mortar, mixed with soda lime and ignited in the usual way. Results have been quite satisfactory.

6. *Sugar.*

Fifty c. c. of milk are run from a pipette into a 250 c. c. flask, diluted with 150 c. c. of water and a few drops of acetic acid added. It is then heated on the steam bath nearly to 100° C. for a few moments to separate the casein and albumen. After cooling, the flask is filled to the mark and the contents filtered; 10 c. c. of the filtrate, equivalent to 2 c. c. of milk are boiled with 50 c. c. of Fehling solution. The precipitated red oxide of copper is dissolved in an acid solution of ferric sulphate and titrated with a standard solution of potassium permanganate in the manner directed for the estimation of sugar in cane juice. A curve on the chart, described in the section on determination of sugar, represents the reducing power of milk sugar and shows directly from the quantity of potassium permanganate used the amount of sugar in two c. c. of milk.

It is, however, sufficiently accurate in normal milk, if a complete analysis is made, to estimate the sugar by difference, as the following table shows. The figures given are not selected, but include every analysis made during the year in which all the constituents of the milk were determined.

SUGAR IN MILK.

	By analysis. Per cent.	By difference. Per cent.
1	5.01	5.02
2	4.71	4.67
3	5.02	5.04
4	5.15	4.86
5	5.15	4.82
6	5.19	5.18
7	5.21	5.39
8	5.16	5.05
9	5.13	5.47
10	5.21	5.12
11	5.14	5.21
12	4.56	4.59
13	4.44	4.23
Average	5.01	4.97

7. *Ash.*

The ash is obtained by burning the dried residue, obtained in an evaporator with asbestos as directed in section 3, at low redness. It is, however, unnecessary, provided sufficient asbestos is taken to dry the milk before applying the lamp. The milk will dry upon the asbestos and burn without spurting.

III. THE ESTIMATION OF SUGAR.

1. *Cane Sugar.*

The investigations of Dr. Peter Collier have shown that the amount of cane sugar found in cane juice, by means of the polariscope and by the chemical method, agree quite closely with each other, the amount obtained by the former method being a trifle lower than that by the latter. The polarization method in view of the fact that the error, if it is an error, is on the safe side has, therefore, been adopted for the estimation of cane sugar in the juice of cane.

The juice, expressed from two or three stalks of cane by a hand mill, is tested with a hydrometer for specific gravity, the weight of the stripped cane and also of the juice obtained being taken, to ascertain the relative amount of juice.

To 100 c. c. of the juice are added 10 c. c. of a solution of subacetate of lead, the liquids being thoroughly mixed together and filtered. The filtrate is tested with the polariscope in the usual way.

2. *Glucose and Invert Sugar.*

Glucose and invert-sugar have been determined volumetrically by Mohr's method, certain modifications, mentioned below being introduced.

The solutions required are:

1. Fehling solution prepared according to the formula of Soxhlet, viz.:

(*a*.) 69.278 grams of crystalized cupric sulphate are dissolved in water to one litre, and

(b.) 346 grams of Rochelle salt and 80 grams of caustic soda are dissolved in water and made up to one litre.

The solutions are kept separate and mixed together in equal volumes when a test is made.

2. An acid solution of ferric sulphate containing about 40 grams of ferric sulphate, and 40 c. c. of concentrated sulphuric acid to the litre.

3. A solution of potassium permanganate of known strength. A convenient solution is prepared by dissolving 3.5 grams of the commercial salt in one litre.

The preparation of a standard solution of potassium permanganate, by dissolving a definite weight of the salt to a given volume, without testing its value, as has been recommended by some chemists, is liable to lead to grave errors as the salt obtained in the market is seldom pure.

Solution (3) may be standardized with iron or oxalic acid in the usual way, but it is more satisfactory to find its value in sugar directly, as in this way the error due to different concentrations of the sugar solution may be avoided.

The standardizing is accomplished with a two per cent solution of sugar as follows: Four grams of pure cane sugar are dissolved in about 150 c. c. of water in a 200 c. c. flask, and two c. c. of concentrated hydrochloric acid added. It is then heated one-half hour on the steam bath to invert. After cooling, the acid is neutralized with sodium carbonate, and the flask filled to the mark with water. The solution now contains invert-sugar equivalent to two grams of cane sugar in 100 c. c. From this solution other solutions are prepared containing invert-sugar equivalent to .25 gm., .5 gm., 1 gm. and 1.5 gms. of cane sugar, respectively, in 100 c. c.

Ten c. c. of one of these solutions is added to fifty c. c. of Fehling solution, in a flask of about 200 c. c. capacity. The Fehling solution is not heated before adding the sugar solution, as more uniform results have been obtained when the solutions were mixed cold. The flask is heated over the lamp till the liquid begins to boil, when it is removed to the steam bath and kept hot for ten minutes. The contents of the flask are filtered, while hot, through an asbestos filter, prepared, in a funnel, as directed for the filtration in the estimation of crude fibre in fodder analysis. The red oxide of copper that remains in the flask need not be removed, but is washed by decantation with hot water, pouring the liquid through the filter. The filtration and washing are facilitated by the filter pump, and is accomplished in two or three minutes. When washed the precipitate, with the filter, without allowing it to dry, is returned to the flask in which the reduction took place, and 100 c. c. of the solution of ferric sulphate added. Any particles of the precipitate that adhere to the funnel may be removed by pouring a portion of the ferric sulphate solution through it. The flask is then corked and vigorously shaken for a moment till the precipitate is entirely dissolved. The solution of potassium permanganate is now run into the flask from a burette, till it imparts a slight color to the liquid and the quantity required noted.

This operation should be repeated two or more times with each solution of sugar prepared, the mean of the results obtained giving the amount of permanganate corresponding to a given strength of sugar solution.

From the data thus found a table may be formed, by interpolation, giving the amount of sugar corresponding to each cubic centimeter of permanganate, but a better way is to construct a curve representing the reducing power of the sugar in the different solutions; for this purpose a sheet of cross-section paper divided in tenths is convenient. Each division on the ordinates is made to represent one milligram of cane sugar, and those on the abscissas 0.2 c. c. of permanganate. Connecting the points found above we have a curve which shows the amount of cane sugar corresponding to any number of cubic centimeters of permanganate. The curve represents cane sugar, but from the known ratio of reduction which the other sugars (dextrose, levulose, milk sugar, etc.) have to invert-sugar, the curve for each is readily constructed, ninety-five parts of cane sugar being equivalent to one hundred parts of invert-sugar.

The reducing powers of the several sugars, which the chemist is most often called upon to determine, is represented, according to Soxhlet, by the following ratio: Dextrose : invert-sugar : milk sugar = 105.2 : 101.2 : 74.

It follows that the curve constructed for cane sugar agrees very closely with that for glucose, and may be used without serious error in determinations of glucose in cane juices and other solutions containing only a small percentage. A correction for the slight difference is, however, readily made when desired.

When many analyses are to be made the time consumed in constructing the curve is more than saved in the calculations, and when once constructed it is availabe for all subsequent determinations, if the solution of permanganate is made of the same strength.

This method of standardizing the permanganate eliminates the errors arising from impure re-agents, and also the titration error of the individual, if the standardizing is done by the same person who makes the analysis.

To enable others who may adopt this method to compare their results with those obtained here, the following table, showing the amount of cane sugar corresponding to each cubic centimeter of permanganate used, is inserted. One cubic centimeter of the solution of permanganate is equivalent to 6.9 milligrams of copper reduced to cuprous oxide.

Permanganate c. c.	Cane sugar milli-grams.	Permanganate c. c.	Cane sugar milli-grams.	Permanganate c. c.	Cane sugar milli-grams.	Permanganate c. c.	Cane sugar milli-grams.
1	3·0	17	56·0	33	115·0	49	177·1
2	6·1	18	59·6	34	118·8	50	181·1
3	9·2	19	63·2	35	122·5	51	185·2
4	12·3	20	66·9	36	126·3	52	189·5
5	15·5	21	70·4	37	130·0	53	193·5
6	18·8	22	74·1	38	133·8	54	197·6
7	22·0	23	77·9	39	137·6	55	201·8
8	25·2	24	81·4	40	141·5	56	206·0
9	28·5	25	85·0	41	145·4	57	210·2
10	31·8	26	88·9	42	149·3	58	214·6
11	35·1	27	92·5	43	153·2	59	219·0
12	38·5	28	96·3	44	157·2	60	223·5
13	42·0	29	100·0	45	161·1	61	227·9
14	45·4	30	103·8	46	165·0	62	232·2
15	48·9	31	107·5	47	169·0	63	236·6
16	52·4	32	111·2	48	173·0	64	241·0

The examination of a solution containing an unknown amount of sugar is conducted in precisely the same way as the standardizing of the permanganate, 10 c. c. of the sugar solution, and 50 c. c. of the Fehling solution being taken in each case. The sugar solution may contain as much as two per cent of sugar but should not contain much more, as in that case the 50 c. c. of Fehling solution may not be sufficient. At the end of the re-action, the liquid should be distinctly blue from unreduced copper.

In the examination of cane and other juices, 22 c. c. of the juice prepared for the polariscope test, equivalent to 20 c. c. of the original juice, were diluted to 50 c. c. and 10 c. c., equal to 4 c. c. of the original juice, titrated for glucose. If the juice should be very rich in glucose it might be necessary to dilute the solution to 100 c. c. instead of 50 c. c.

For the estimation of cane sugar in cane, 11 c. c. of the clarified juice equal to 10 c. c. of the original juice were diluted with about 50 c. c. of water, inverted with concentrated hydrochloric acid, neutralized with sodium carbonate and made up to 100 c. c. Ten c. c. equal to 1 c. c. of juice are titrated for total sugar. The glucose, found subtracted from the total sugar, gives the cane sugar.

The method is rapid and gives very satisfactory results as the following duplicate analyses of six samples of cane juice for glucose show :

	Per cent of glucose in cane juice. I.	II.
1	3.22	3.18
2	3.84	3.85
3	3.69	3.66
4	3.99	3.97
5	3.72	3.74
6	3.24	3.27

Only two determinations of cane sugar were made by the chemical method this year, these together with the polariscope test are given below:

	Cane Sugar. By Polariscope.	Chemical Method.
1	11.13	11.30
2	11.62	11.56

IV. ANALYSIS OF FERTILIZERS.

The determination of phosphoric acid has, in all cases, been made by Pemberton's volumetric method, with ammonium molybdate, as modified by Prof. Caldwell in the second report of the Cornell university experiment station. Soluble phosphoric acid has been separated by digesting, with frequent shaking, 10 grams of substance in 500 c. c. of water and titrating 50 c. c., equal to 1 gram. Reverted phosphoric acid is separated by ammonium citrate precipitating directly with magnesia mixture, according to Peterman's method, as directed by Prof. Johnson in the Connecticut experiment station report, but instead of igniting and weighing this precipitate as recommended by him, it has been dissolved in nitric acid and titrated with ammonium molybdate. This not only saves time but avoids the possible error arising from the precipitation of lime with the phosphoric acid.

Nitrogen and potash have been determined in the usual manner.

REPORT

OF THE

HORTICULTURIST.

INTRODUCTION.

A conspicuous and important part of our garden work the past season has been our somewhat exhaustive test of varieties. Seeds were planted of almost the entire list of garden plants offered by our American seedsmen, as well as many others from foreign countries. In this work we have had other objects in view than the mere comparison of yields and qualities. All who have made the least study of varieties in vegetables know that there is much confusion in nomenclature. We have endeavored, as far as possible, to discover how many of the so-called varieties planted are really distinct, and how many are only synonyms. We have also desired to study the fixity of varieties, the trueness to which seeds reproduce to name and the variation, which are apt to occur.

While the work of purifying nomenclature may not be regarded as strictly experimental, we believe that it is entirely appropriate to the objects of the station. In the department of fruits we recognize veteran workers in this field whose creditable labors we are not as yet called upon to supplement or to review, but our study of vegetables has shown the confusion of names so conspicuously that we are led to regard some systematic effort to rid our list of varieties from the many synonyms and misnomers as of great importance.

The labors in this field of Mr. Fearing Burr, Jr., of our own country, and of M. Louis Vilmorin, of Paris, are highly creditable, yet the very success that they have obtained brings into greater prominence the deficiencies in our knowledge which exist.

The large number of so-called new varieties that are constantly being offered to the public as well as the many old ones whose distinctness is questioned, makes it important that this work be carried beyond the present limits, and that some method of classification for the purpose of identification shall be established. The results of our investigations in part are appended in treating of the different vegetables separately.

We have also sought to make a complete and accurate description of every distinct variety grown. It has been our aim to note and delineate the peculiar characteristics of each variety in such a way that the intelligent gardener may be able to determine from these descriptions whether or not his varieties are true to name, but our work in this line must be deferred for further study before publication.

We regret that we have not accomplished all that we hoped for in this direction. A lack of time has somewhat prevented the very thorough study of varieties that we desired to make. The cold and wet summer also nearly thwarted our plans with the cucurbitaceous plants, while our eagerness to discover a preventive for the cabbage-worm (*pieris rapae*) tempted us to use applications that proved injurious to many varieties of cabbage and fatal to a few. A mixture of seed purchased has also at times made it impossible for us to certainly identify some varieties. Despite these embarrassments, however, we feel that we have made a good beginning in this work.

Last, though not least, we have hoped that a careful study of the laws of growth, as illustrated in our varied exhibition of plant life, might suggest ideas that would prove of value in the more important work of future experimentation.

Our work has not been confined to a test of varieties. We have carried on quite an extensive series of experiments in different branches of horticulture, the results of which will appear in their appropriate places.

In order to economize space we have condensed as far as possible the more important data gathered from our work in tabular form, adding such explanations, remarks and suggestions as seem appropriate.

In case the yields of some of our varieties should seem meagre to some gardeners into whose hands this report shall fall, we add by way of apology that the large number of varieties grown could not be accommodated within the limits of the former station garden, and we were therefore compelled to appropriate a portion of the farm that had not previously been devoted to garden purposes, and which was not, in consequence, in a thorough state of preparation.

We regret that we have not more to offer upon the subject of fruits. Few of the fruit plants set out in the spring of 1882 are as yet old enough to bear, and we must acknowledge also that our list of the newer varieties is as yet quite incomplete.

It is our desire to grow and test all new fruits as they are brought out, and in this we must ask the co-operation of fruit growers, as very many of the new varieties are not offered for sale until they have already been well tested. Any sample fruit plants of promising varieties sent to us for trial by the originators will receive careful attention, and will be reported upon in due time according to their merits under our conditions. We have already received some gifts of this kind, which are duly acknowledged in the report of the director.

BEET.

Our list of beets, including the sugar beets and mangels, embraced thirty-one named samples. The seeds were planted April 26, in rows ten feet long, and twenty-one inches apart, two rows of each sample. In the first of the two rows one hundred seeds, or, speaking more ac-

curately, one hundred seed-cases were planted. What are usually called beet seeds, are collections of small utricles, each of which may contain a seed. As will appear in the table, the number of plants that grew from the one hundred seed-cases planted, is usually more than one hundred.

The plants were thinned in the row to three inches apart, but we noted that the end plants of nearly every row were best developed, which indicates that they should have been given more room.

The statistics noted are as follows :

NAME.	Commenced to vegetate in — days.	Number of plants vegetated.	Fit for table use in — days.	Weight of roots.	
Beet.				lbs.	oz.
Bastian's early blood turnip.......	14	160	81	44	0
Dewing's improved blood turnip....	14	139	85	35	2
Early blood turnip...............	14	103	85	30	2
Improved early blood turnip......	14	73	81	39	14½
Hatch's blood turnip.............	14	123	81	35	11
Dark red Egyptian................	14	125	81	29	14½
Dewing's extra early turnip.......	14	68	81	36	1
Early yellow turnip..............	14	138	83	33	9
Early turnip Basano.............	14	171	83	53	2
Bastian's half long blood..........	14	192	77	40	12
Henderson's dwarf pine apple.....	16	73	89	26	3
Henderson's pine apple...........	14	124	89	44	9
Crapaudine......................	14	127	96	24	15
Erfurt black red.................	16	91	96	31	10
Eclipse	14	70	83	34	3
Extra long dark blood............	14	137	92	28	13
Long dark blood	14	71	96	24	1½
Simons' early	14	162	85	33	7
Dell's flower garden	16	45	..	14	6½

NAME.	Commenced to vegetate in — days.	Number vegetated.	Weight of roots.
Mangel.			lbs oz.
Long red	14	74	56 14½
Mammoth long red	14	145	44 6½
Henderson's colossal long red	14	104	41 9
Norbiton giant	14	96	42 13½
Long yellow	14	42	36 10½
Orange globe	14	54	34 0
Yellow ovoid	19	68	39 13
Red ovoid	14	134	23 13½
Sugar beet:			
Lane's imperial white	14	157	36 6½
White French	14	169	59 10½
White imperial	14	160	34 2½
Yellow French	22	36	42 9

Our standard of earliness is necessarily rather arbitrary, as the time was reported before the roots were full grown.

As grown by us the Eclipse and Dark Red Egyptian beets seem to be synonyms, as do also the Norbiton Giant and Mammoth Long Red Mangel, and Henderson's Colossal Long Red and Long Red Mangel. Henderson's Pineapple and Henderson's Dwarf Pineapple are distinct. The lines of distinction between the Early Blood Turnip, Dewing's Early Blood Turnip, Dewing's Extra Early Turnip, Improved Early Blood Turnip, Bastian's Early Blood Turnip, Hatch's Blood Turnip, and Simon's Early, are extremely obscure. With our present knowledge we would not pronounce them synonyms, though we say unhesitatingly that so far as appearance is concerned we can pick samples from each of these so-called varieties that would pass undetected in any or all of the others. We are convinced either that the seed of these several names was mixed, or that the roots that produced the seed were not carefully selected to definite types. Otherwise the beet (and carrot as well) will not admit of such fine discriminations as our seedsmen would have us believe. We would not forget, however, that the flowers of the beet are subject to cross-fertilization, and that this might, in some cases, overbalance the most careful selections of the seed-grower.

Our long-rooted varieties of mangel showed much variation in form. A large proportion of the roots did not project themselves above the soil at all.

We also planted four so-called varieties of Swiss chard, or leaf beets, viz.: Beck's Improved Sea Kail, Large Ribbed White Silver, White, and Yellow Swiss Chard. The foliage of the first of these varieties

was decidedly more vigorous and more uniform than that of the other varieties, all of which seemed much mixed. The foliage of the chard is used as greens throughout the season, and the petioles and midribs are sometimes cooked and served like asparagus. It is interesting to notice that in this plant, in which the foliage has been the object of selection, the leaves are not only much more ample, but are much more puffed or blistered than in the varieties of the common garden beet.

Carrot.

We planted seeds of carrot from twenty named packages April 26, in rows twenty-one inches apart and ten feet long, two rows of each sample. The statistics noted appear in the following table:

NAME.	Commenced to vegetate in — days.	Per cent vegetated.	Roots of marketable size in — days.	Weight of roots. lbs.	oz.
Altringham Long Red	28	27	98	16	8
Danvers	23	29	85	51	7
Early French Scarled Forcing	23	49	83	38	0
Early Scarlet Short Horn	23	47	92	51	10
Gartier's Red Horn	19	66	80	38	5½
Half Long Scarlet Carentan	28	72	85	49	10
Half Long Luc	28	45	85	36	2
Half Long Red Pointed	28	19	89	39	15
Half Long Scarlet Nantes	28	23	85	63	3
Half Long Stump Rooted	23	58	85	44	6
Improved Long Orange	28	19	98	44	8
James' Intermediate	28	25	85	35	3
Long White Belgian	28	39	89	43	1
Long Orange	23	37	98	40	2
Long Red Surrey	28	26	98	22	8½
Transparent White	28	23	89	49	9
Violet or Purple	32	22	100	21	2½
Carrot from Norway	28	60	92	41	1

The date of "marketable size" was of necessity somewhat arbitrary, as we did not wish to destroy the plants. We think it is relatively correct, however, in the different varieties.

The Altringham Long Red and Long Red Surrey ran to seed so early in the season as to nearly destroy the crop of roots. The same tendency appeared, but in a less degree, in the Half Long Luc, Large White Belgian and Violet or Purple. In the former two varieties we noticed a similar tendency last season. We do not find this noted as being a common characteristic of these or any varieties of cultivated

carrot, and whether it is due to the seed, soil or season, we are not informed, but in the Long Red Altringham and Long Red Surrey we ascribe it chiefly to the seed.

As appears from the table, the Gartier's Red Horn and Early French Scarlet Forcing, which are very possibly the same variety, were earliest, while the Half Long Scarlet Nantes was most productive.

The variety "from Norway" seed of which was presented by Messrs. Hiram Sibley & Co., very closely resembled the Danvers in form, but was later, and a little less productive.

The James' Intermediate and the five "Half Long" varieties as grown on our soil, so closely resembled one another that samples answering to the description of each variety could readily be taken from every row.

PARSNIP.

We planted seeds from eight packages which came to us labeled as follows: Abbott's Hollow Crown, Carter's New Maltese, Early Round or Turnip, Guernsey or Cup, Long White Dutch, Round, Sutton's Student and Turnip Rooted.

As we have not yet harvested the roots, we give no report of the productiveness of the different samples. We have, however, examined specimens from them all.

We were able to detect little if any difference in the foliage of the different samples as grown in the Station garden.

Although the number of so-called varieties of parsnip is smaller than in the majority of our vegetables, we have very good evidence that the number should be much reduced. In our experience of last year we pronounced the Long Hollow Crown and the Carter's New Maltese as synonyms. Vilmorin* classes the Hollow Crown, Student, Long Smooth and Long de Guernsey as one variety, and Burr† considers the Guernsey and Long Smooth as synonyms.

We have been able to detect no difference between the samples labeled Abbott's Hollow Crown and the Long Hollow Crown (the latter grown last season, nor between the Early Round or Turnip, Round and Turnip Rooted.

These combinations, if warrantable, reduce the number of varieties of parsnip to three, viz.: Long White Dutch, with the synonyms Common or Dutch, Long Smooth Dutch, Large Dutch (of the catalogue), *Panais long* (French); Hollow Crown, with the synonyms Long Hollow Crown, Abbott's Hollow Crown, Hollow Crowned, Student, Sutton's Student, Long Smooth, Guernsey or Cup, Carter's New Maltese, *Panais long de Guernsey* (French), *Grosse lange Pastinake* (German); and Turnip Rooted, with the synonyms Round, Early Round or Turnip, *Panais rond, P. court, P. royal, P. de Metz, P. de Siam* (French), *Runde Pastinake* (German).

In 1828 Thorburn offered but one variety, the Large Dutch. We learn from a report of the Department of Agriculture that seeds of the Hollow Crowned parsnip were introduced from England, and of the "Round," "*Panais rond*" (French), from France in the year 1854.

* Les Plantes Potagères, p. 399.
† Garden Vegetables, p. 25.

We grew one row of the wild parsnip, *Pastinaca sativa*, adjoining the rows of the named varieties. The roots were little inferior in size, but were decidedly more rough and branching. The cultivated varieties of parsnip show far less differentiation as compared with the wild form than those of the carrot. It seems reasonable, therefore, to hope that decided improvements may yet be made in this vegetable.

Radish.

We planted seeds of radish from eighteen named packages in the open ground May 4, and a second planting of the same samples in the frame of the hot-bed on July 9.

We had opportunity to note the difference in the quality of the roots as grown early in the season in common garden soil, and later in the highly fertilized soil of the hot-bed frame. Those of the first planting, which necessarily developed slowly, and were hindered more or less in their growth by the cabbage flea beetle, were tough, stringy and worm-eaten, while those of the later planting, developing quickly, and being sheltered from insects by the hot-bed frame, were as juicy and tender as one could desire.

The seeds of several of the varieties were much mixed, those of the Olive White being more than seventy-five per cent spurious.

We have noted the following statistics of the two plantings:

NAME.	Commenced to vegetate in — days.	Per cent vegetated.	Roots of edible size in — days.	Second planting of edible size in — days.
Daikon from Japan	9	8	....	.....
Early Long Scarlet	8	66	46	24
Early Long Scarlet Short Top	8	41	49	.....
Early Scarlet or Red Turnip	13	21	44	24
Early Scarlet Turnip Rooted	9	17	50	24
Scarlet Turnip Rooted	8	83	47	24
Early Yellow Turnip	9	43	47	24
Ferry's Perpetual Market	8	72	52	30
French Breakfast White-tipped	9	31	50	24
Golden Globe	8	39	49	29
White Turnip	9	42	52	29
Long White Naples	8	34	52	.....
Long White Russian	8	59	50	30
Olive White	9	14	47	24
Olive Rose	8	34	51	24
Olive Gray	9	47	....	30
Olive Scarlet	9	46	49	24
Wood's New Frame	8	25	50	24

In the first planting we have the better opportunity to note the comparative earliness, as the difference is more marked owing to their slow development. The Early Long Scarlet was earliest, being fit for table use June 18, one day earlier than the Scarlet Turnip-rooted, or the Early Yellow Turnip. Ferry's Perpetual Market and the White Turnip were slowest in development.

The "Daikon," seeds of which were obtained from Japan through the courtesy of Messrs. Hiram Sibley & Co., is a very distinct variety, but it ran to seed before becoming sufficiently large for table use.

The Early Scarlet or Red Turnip, Early Scarlet Turnip-rooted and Scarlet Turnip-rooted seemed the same variety.

RUTA-BAGA.

We planted seeds of ruta-baga from sixteen named packages in the garden July 7, in rows three and one-half feet apart, and ten feet long, one row of each sample, the seeds being planted half an inch deep.

We have noted the following statistics:

NAME.	Commenced to vegetate in — days.	Roots of edible size in — days.	Total yield of roots.
			lbs.
American	5	84	13¼
Bangholm	6	84	13¼
Carter's Imperial Swede	6	84	13½
Curly Top	7	98	8
Hartley's	6	84	14¼
Improved Yellow	5	86	9
Laing's Purple Top	9	93	5¾
London Swede	5	86	10
Marshall's Extra Purple Top	6	86	9½
Purple Top	6	83	12
Shamrock	6	84	16½
Skirving's Purple Top	6	84	14
Sutton's Improved Champion	6	86	12¾
White Swede and Russian	5	86	12¾
White Sweet German	5	86	9¾
A variety from Norway	5	84	11¼
Carter's Imperial Swede (duplicate)	..	86	9¾

In our test, which is on a very limited scale, the Shamrock proved most productive, and it was as early in development as any of the samples.

The ruta-baga is much more hardy than the common turnip. We planted on the same day and in the same manner, seeds of thirty-four so called varieties of common turnip, but these yielded a very small crop

of roots; so small that we have not noted the yields, as owing to the irregularity of the vegetation of the seeds, we could not consider it as a test of their comparative productiveness.

Onion.

We planted seeds of onion from thirty-four named packages April 23, 24 and 26, in rows ten feet long, and eleven and one-half inches apart, covering the seeds, as nearly as possible, one-half inch deep. To ascertain the percentage of vegetation, we carefully counted in one hundred seeds of each variety separating these by stakes from the remainder of the planting.

We planted three rows of each variety, and in order to note the effect upon the yield of different distances between the plants, we thinned the plants in the first row to three inches apart; in the second to two inches, and in the third to one inch apart, respectively.

The data noted appear in the following table :

ONION.	Commenced to vegetate in — days.	Per cent vegetated.	Ripe in — days.	Yield of first row.		Yield of second row.		Yield of third row.		Total yield.	
				lbs.	oz.	lbs.	oz.	lbs.	oz.	lbs.	oz.
Brown Teneriffe	31	26	134	3	15	6	0	8	4	18	3
El Paso or large Mexican	22	45	130	5	4	5	4	8	0	18	8
Etna pale red	17	65	130	5	0	5	0	6	12	16	12
Wells' extra early	21	76	117	6	4	6	0	.....		.....	
Extra early red	22	65	129	7	12	7	0	10	8	25	4
Extra early red (duplicate)	21	66	116	5	0	6	0	7	8	18	8
Flat Madeira	22	82	154	12	15	11	8	19	8	43	15
Giant Rocca of Naples*	22	61	163	9	4	8	12	11	12	29	12
Globe Maderia*	24	74	163	10	5	10	8	14	0	34	13
Golden queen*	24	64	163	5	10	6	12	7	0	19	6
Large red Italian Tripoli	24	45	134	6	14	9	0	11	12	27	10
Large red Wethersfield*	24	28	163	6	9	8	8	10	0	25	1
Large red Wethersfield (dup)*	24	79	163	9	4	9	4	10	12	29	4
Large Strasbourg*	24	32	163	3	6	3	12	5	0	12	2
New Neapolitan*	24	41	163	6	14	7	4	8	4	22	6
Nocera	30	8	121	0	8	0	12	1	0	2	4
Red basano or Genoa	24	52	121	5	4	4	12	5	8	15	8
Red Genoa	24	59	121	3	8	4	0	6	0	13	8
Red globe	22	45	163	6	12	9	0	10	0	25	12
Red globe, early	21	42	157	7	1	8	0	10	12	25	13
Etna, silver white	21	54	134	4	11	4	8	4	12	13	15
Philadelphia white	16	49	151	5	7	5	0	8	0	18	17
White calabria	21	72	120	4	4	4	8	5	8	14	4
White globe	21	71	154	10	4	11	8	15	0	36	12
White Lisbon*	21	66	163	6	9	8	0	12	8	27	1
White Naples*	21	46	163	6	0	9	4	10	4	25	8
White Portugal	21	87	151	7	0	7	12	12	8	27	4
White Portugal (duplicate)	21	56	154	7	12	8	0	10	4	26	0
White silverskin	21	45	129	3	8	3	12	6	0	13	4
Yellow cracker	21	88	129	4	12	4	8	4	12	14	0
Yellow Danvers	21	72	151	5	5	7	8	9	0	21	13
Yellow Danvers (duplicate)	21	57	151	6	11	7	12	9	0	23	7
Danvers yellow globe	21	62	154	7	6	7	4	8	4	22	14
Large yellow Dutch	21	83	154	6	13	7	4	10	4	24	5
Large yellow	19	59	152	7	11	8	0	9	12	25	7
Yellow globe	19	86	152	9	3	9	4	12	0	30	7

Seeds purporting to be of the "New Queen" and "Large white flat Italian Tripoli" varieties were also planted, but proved to be spurious. In the four cases, where duplicate plantings are noted, seeds of the same variety obtained from two different seedsmen were used.

*Pulled before the tops were all dead.

It appears that in nearly every case the yield was smallest in the first, and largest in the third row, but in no case was the increase in the yield of the second and third rows in proportion to the increased number of plants. We noted that, as a rule, the largest bulbs were in the first row.

As an additional experiment in growing onions at different distances apart, we planted, June 3d, four rows of the large red Wethersfield variety, sowing the seed thickly. After the plants had vegetated, we thinned those in the first row to six inches apart, those in the second to three inches apart, those in the third to one inch, while those in the fourth were not thinned. The planting was done too late to obtain the best results, but we note the yields, as follows: The first row yielded two solid bulbs and twenty-six scallions; the second row yielded eight solid bulbs and thirty-seven scallions; the third thirteen solid bulbs, thirty-five scallions, with many undeveloped plants, and the fourth yielded fifty-seven solid bulbs and fifty-seven scallions.

These results seem to indicate that there is some foundation for the opinion held by some onion growers, that the bulbs develop better where they touch each other in the row than where they do not.

Another experiment with onions is quite suggestive. We saw a statement in an agricultural newspaper that onions will succeed better on a compact than on a loose soil, provided that the surface is well pulverized to a slight depth. With the view of verifying this experiment, we thoroughly pulverized the soil on a small plat of ground, and on an adjoining plat of equal size we packed the ground as hard as possible by repeatedly pounding it with a heavy maul. We then covered the surface of both plats with finely pulverized soil to the depth of half an inch, and, June 3, planted three rows on each plat with seed of the large red Wethersfield onion. The late planting undoubtedly prevented a fair yield, but the three rows on the compacted soil yielded nine pounds, seven ounces of merchantable bulbs, while the three on the pulverized soil yielded but three pounds, three ounces. The percentage of vegetation in the two plats was not noticeably different, although the vegetation was more prompt in the compacted soil. We hope to repeat this experiment the coming season on a more extended scale.

We also planted, April 26, seeds or sets of the following plants belonging to the onion family, with the results noted.

SHALLOTS, LEEK, ETC,	Commenced to vegetate in days.	Per cent vegetated.	Ripe in days.	Weight of bulbs. lbs.	oz.
Shallots, from seed	28	23	...	12	3
Shallots, from sets	13	..	127	6	12
*Leek, London flag	28	54	161	13	10
*Leek, Musselburg	28	12	161	4	11
*Welsh onion	30	55	161	14	14
Garlic, from sets	..	..	127	3	4
Chives, from sets	36	..	...	..	..

* Pulled before the tops were all dead.

Melon, Squash, Cucumber.

As we have already remarked, our cucurbitaceous plants were not a decided success. The cold season and the heavy soil, combined with the depredations of insects, were so unfavorable to the development of the plants that many of them failed to perfect a fruit. We will not present our results in tabular form, but will simply note those so-called varieties that were sufficiently hardy to mature a fair crop of fruit, despite the unfavorable conditions. We planted one hundred seeds of each of the so-called varieties offered by our leading seedsmen, in drills ten feet long, first mixing with the surface soil a layer of coal ashes two inches thick. The application of the coal ashes was an experiment intended to prevent, in a measure, the severe baking to which our heavy soil is so liable. The seeds were planted May 17 and 18.

Of muskmelons the following matured a fair crop of fruits: Allen's Superb, Boston Large Nutmeg, Boston Pet, Burpee's Netted Gem, Cassaba, Early White Japan, White Japanese, Green Nutmeg, Hackensack, Improved Orange Christiana, Christiana, Jenny Lind, Long Persian, Log of Wood, Pineapple, Prolific Nutmeg, Sill's Hybrid, Skillman's Fine Netted, New Surprise and Valparaiso.

The following were not total failures: Ward's Nectar, Shaw's Golden Superb, Round Yellow Cantaloupe, Chicago Nutmeg and Bay View.

In flavor we found the Boston Pet and Chicago Nutmeg very superior. Burpee's Netted Gem was very prolific, though the fruits were quite small. The Log of Wood was the first to mature a fruit, ripening a specimen on September 18. The Improved Orange Christiana and Christiana are undoubtedly the same variety. The Early White Japan and White Japanese, however, are distinct.

Of watermelons, but three matured a fair crop, viz.: Apple Pie, Apple Seeded and Odella. The following, however, were not total failures: Black Italian, Black Spanish, Citron, Cuban Queen, Early Jersey, New Round Excelsior, Gypsy, Golden Fleshed, Goodwin's Imperial, Peerless or Ice Cream, Phinney's Early, Sculptured Seeded Japan and Vick's Early.

Of squashes the following matured a fair crop: Early White Bush Scallop, Early Yellow Bush Scallop, Green Striped Bergen, Perfect Gem, Summer Golden Crookneck, Turban, Canada Crookneck and Vegetable Marrow. The following were not total failures: Mammoth, Low's Premium Hybrid, Essex Hybrid, Custard Marrow, Butman and Boston Marrow.

The Low's Premium Hybrid, Essex Hybrid and Turban are scarcely distinct, but owing to the limited number of fruits produced, we would not declare them synonymous.

Of cucumbers the following produced a fair crop: Boston Pickling, Early Russian, Early Short Green, Extra Long White Spine, Long Green, Perfection Pickling and Tailby's Hybrid. The Early Short Green and Tailby's Hybrid really did well. The New Jersey Hybrid, White Spine, Long Green Smooth, Early Frame and Early Cluster were not total failures.

We also planted seeds of five so-called varieties of pumpkin and ten of gourd, but few fruits of either matured.

Many of our cucumbers and squashes showed unmistakable evidence of cross-fertilization, and clearly indicated, on the part of those who produced the seed, a lack of sufficient care in isolating their varieties. The blossoms of the melon, cucumber and squash cannot in any case self-fertilize, and hence, unusual precautions are necessary to prevent the mixture of varieties.

For a detailed account of our experiments upon the insects which infest these plants, we refer the reader to the article on insecticides.

CABBAGE.

We planted 100 seeds of cabbage from each of fifty-six named packages in seed-boxes in the greenhouse, April 24th, 25th and 26th. Eleven plants of each were transplanted to the garden May 26, each sample occupying a row twelve feet long. The plants were afterward thinned out in the rows where they were thick enough to require it. The data we have noted are as follows:

NAME.	Commenced to vegetate in — days.	Per cent vegetated.	Number of transplanted plants that survived.	First head formed in — days.	Number of heads formed.	Diameter of the largest and smallest head.
						inches.
Early York	4	63	7	114	5	4 5
Early York Dwarf	6	54	10	120	6	4 6
Large Early York	5	63	7	119	1	4
Early Sugar Loaf	5	39	6	133	1	6
Early Oxheart	7	71	4	124	2	3
Early Etampes	5	60	7	104	3	3 6
Early Nonpareil	5	51	4	150	2	4 5
Tourlaville	4	93	10	133	4	6 8
Early Winningstadt	5	84	8	127	1	5
Early Rainham	12	26	4	143	2	6 8
Filderkraut	5	59	9	127	9	3½ 6
*Late Round Winter (from Norway)	5	77	10	132	1	6
Little Pixie	4	55	4	......	......	......
Early Jersey Wakefield (imported seed)	5	74	5	97	3	4 7
Early Jersey Wakefield (American seed)	5	74	6	......	......	......
Henderson's Early Summer	5	77	8	114	4	4½ 8½
Early Wyman	8	21	5	103	3	5 6
Early Bleichfeld Giant	6	72	7	111	2	8 9
St. John's Day	5	85	8	166	3	3 4
Early St. John's Day	8	85	......	......	......	......
Early Drumhead	9	47	7	......	......	......
Wheeler's Cocoanut	5	66	10	127	3	4 6
Schweinfurt	5	64	7	121	4	8 12
Schweinfurt Largest White	4	93	6	110	5	7 12
Schweinfurt Quintal	5	85	2	127	2	12 14
Quintal Drumhead	5	67	6	114	4	8 9
Strasburg Quintal	5	78	8	119	4	6 9
St. Dennis Drumhead	5	76	9	140	1	8
Danish Drumhead	7	71	10	110	8	6 8
Vilmorin's Early Flat Dutch	5	62	10	115	9	4 8
Cannon Ball	5	92	9	112	5	4 8
Fottler's Improved Early Brunswick	4	73	7	114	2	6 7
Fottler's Brunswick	5	55	11	114	4	5 7
Premium Large Late Flat (Dutch)	5	53	6	131	3	6 6
Late Flat Dutch	5	71	9	121	5	7 9½
Early Dwarf Flat Dutch	5	63	8	147	1	7
Crane's Early	8	30	11	127	5	4 7
Large Late Drumhead	4	91	10	......	......	......
Stone Mason	6	64	7	140	3	6 8
Large Late Bergen	7	46	11	142	4	4 8

* Planted May 4.

NAME.	Commenced to vegetate in — days.	Per cent vegetated.	Number of transplanted plants that survived.	First head formed in — days.	Number of heads formed.	Diameter of the largest and smallest head.
						inches.
Silverleaf Drumhead	5	65	4	146	1	7
Marblehead Mammoth	5	78	4	146	2	7 9
Excelsior	4	78	6	112	5	8 10
Early Blood Red Erfurt	5	68	10	......	1	4
Earliest Blood Red Erfurt	......	......	11	166	1	3
Red, for pickling	5	90	8	112	7	4 5
Red Drumhead	5	68	6	119	6	6 6
Fine Red Dutch Pickling	5	68	9	127	4	6 7
Savoy —						
Early Dwarf	4	100	......	......	......	....
Early Ulm	5	78	......	......	......	....
Improved American	4	92	......	......	......	....
Netted	4	98	......	145	2	4 5
Very Early Paris	8	95	....	......	......	....
Victoria	5	58	......	.....	......	....
Early Drumhead	5	78	......	......	......	....
Feather Stem	5	96	......	......	......	....
Tom Thumb	4	81	......	144	7	2½ 5

We do not consider our cabbage test a fair one for two reasons: First, the number of plants transplanted was too small, and second, as we have already remarked, our experiments with various substances with the view of finding an efficient insecticide for the cabbage worm proved injurious in some cases. The injurious applications were more concentrated on some rows than on others, hence we have no means of estimating the relative amount of damage. We present our results, therefore, without drawing comparisons.

The Schweinfurt Quintal, Largest White Schweinfurt, and Schweinfurt, are undoubtedly synonyms, as are also the Quintal Drumhead and Strasburg Quintal.

Seeds of two varieties from Japan, under the names "Broad Leaf" and "Shiro-Na," were presented to us by Messrs. Hiram Sibley & Co., but neither proved to be of any value.

Cauliflower.

We also planted seeds of cauliflower from twenty-two named packages, April 16, of the same number and in the same manner as noted for cabbage. Eleven plants of each sample were transplanted to the garden May 15. As will appear from the following table, some of the plants produced very fine heads, although their treatment was not different from that of the cabbages.

CAULIFLOWER — VARIETY.	Commenced to vegetate in — days.	Per cent vegetated.	No. of tr'nspl'd pla'ts that survived.	First he'd f'm'd in — days.	No. of heads formed.	Diameter of largest head — inches.
Algiers	5	55	6	159	5	9
Algerian Late	5	92	9	142	1	6
Berlin Dwarf	5	52	8	124	2	5
Carter's Defiance	5	70	7	124	6	..
Carter's Dwarf Mammoth	5	69	6	124	2	9
Earliest Dwarf Erfurt	5	47	10	124	4	7
Erfurt Early Dwarf	5	57	6	131	3	5
Early Dutch	7	86	7	142	3	6
Early London	7	56	6	129	4	9
Extra Early Paris	7	54	3	142	2	9
Gerry Island	7	80	3	133	3	6
Imperial	7	33	8	119	7	10
Italian Giant White	5	79	6	175	1	10
Large Late London	5	41	6	128	5	7
Large White French	5	88	8	105	8	6
Lenormand's Short Stem	5	78	5	128	5	8
*Rice's Giant Snowball	5	48	7	152	1	4
Snowball	7	70	5	128	4	6
Stadtholder	7	70	6	128	5	9
Thorburn's Wonderful	5	87	4	128	4	6
Veitch's Autumn Giant	5	65	6	128	3	6
Walcheren	5	64	3	128	3	6

BROCCOLI.

We also grew three samples of broccoli, under the names Cabbage, Carter's Summer, and Early Purple Cape. A portion of all of these formed fair-sized heads. The broccoli closely resembles the cauliflower, the chief difference being that it is more hardy, and is rather less delicate in flavor.

KALE.

We also grew a few plants each of twenty-five so-called varieties of kale, or borecole. The seeds of nineteen of these were obtained directly from Paris. A few of these had beautifully cut and variegated foliage, which made them very attractive, particularly toward the latter part of the season.

LETTUCE.

Our lettuce, from fifty-five named packages, was planted April 27, in rows ten feet long and twenty-two inches apart, two rows of each variety. The plants were thinned in the rows sufficient to give room for their full development The statistics noted are as follows. It will appear that certain varieties do not form heads.

* Planted May 13, transplanted June 20.

LETTUCE.

NAME.	Commenced to vegetate in — days.	Per cent vegetated	Fit for sale in — days.	Commenced to form head in — days.	Commenced to form flower stalk in — days.	Commenced to bloom.	First ripe seed in — days.	Diameter of developed plant.
								Inches.
All the Year Round (black seed)	14	15	45	62	76	101	117	12
American Gathering, new	12	69	43	62	83	101	120	12
Bath Cos Bliss	14	17	45	71	84	112	129	15
Black Seeded Simpson	12	40	41	62	88	117	141	12
Bossin	14	2	50	81	101	148	...	18
Boston Curled	12	11	43	..	78	94	108	9
Brown Dutch	14	14	45	62	80	104	115	12
Brown Geneva Cabbage	14	20	45	62	80	112	125	12
California Gardener's	15	8	50	72	84	105	122	12
Crisp German	12	17	45	62	84	112	127	12
Curled Simpson	11	11	41	..	84	105	117	12
Deer Tongue	12	65	45	..	88	101	115	..
Early Curled Silesian	18	12	48	..	68	94	106	12
Early White Head	14	44	47	62	75	95	108	9
Emperor Frame Cabbage	14	21	50	62	..	94	101	....
Frankfort Head	14	48	48	62	80	105	119	12
French Imperial Head	15	26	50	81	82	105	122	12
Grant White Cos	14	9	45	69	80	112	127	15
Gray Seeded Butter	11	69	47	62	80	105	125	12
Green Cos	11	29	45	69	76	104	115	..
Green Fringed	14	24	50	..	88	110	126	....
Golden Stone Head	12	37	42	62	68	101	122	12
Hammersmith Hardy Green	14	34	47	62	75	94	106	10
Hanson	12	70	41	62	80	106	122	12
Hardy Green Winter	12	39	47	63	75	94	104	9
Ice Drumhead	12	21	43	69	75	95	112	15
Improved Spotted Cabbaging	18	16	50	71	83	112	134	12
India Head	12	47	41	64	81	110	148	12 to 15
Large Princess Head	12	23	42	62	76	104	148	12
Large Whitestone Summer	12	39	41	62	89	116	148	12 to 15
Malta Large Drumhead	11	25	41	69	68	95	133	12
Marvel or Red Bison	14	21	42	62	82	112	148	12
Neapolitan Cabbage	12	37	41	62	76	109	148	....
New Orleans Green Cabbage	14	21	41	62	75	105	148	12 to 14
Perpetual	11	61	41	62	83	105	122	12
Perpignan	15	11	47	62	80	109	120	....
Philadelphia Butter	12	62	41	62	68	94	106	10 to 12
Prize Head	11	73	41	62	84	104	117	12
Prize Head, Early	11	77	41	62	84	104	119	12
The Deacon	14	15	45	62	88	115	138	12
Yellow Seeded Butter	14	44	..	64	68	112	138	9
Yellow Butter, large	13	41	50	62	84	112	126	10
Wheeler's Tom Thumb	14	50	43	62	76	105	125	9
White Forcing Head	12	19	41	62	64	94	106	9
White Cos	12	44	41	65	75	94	101	....
White Chavigny	13	45	41	62	91	130	107	12
White Cabbage	13	21	42	62	68	105	117	12
White Batavian	13	42	41	62	80	112	126	12
Versailles' Cabbage	27	7	45	62	64	115	127	12
Tennis Ball, white	13	78	41	62	68	96	106	9
Sugar Loaf	13	52	41	62	80	105	117	12
Shotwell's Brown Head	13	40	41	62	111	....	..	12
Satisfaction (black seeded)	13	45	41	65	76	104	117	12
Salamander	12	58	41	62	76	105	117	12
Red Bison	12	47	42	62	80	105	119	12

We also planted seeds of samples named green flat cabbage, White Paris Cos, Victoria cabbage, Black Seeded Tennis Ball, and White Seeded Satisfaction. The first two failed; the remainder were spurious.

Among the fine heading varieties we would name Salamander, the Deacon, White Chavigny, and White Cabbage. Some of these reminded us of of miniature cabbages. The Deer Tongue, a new and very distinct variety, though rather homely in appearance, is very tender, with a sweet, pleasant flavor, which is retained until the seed stalk commences to form.

SYNONYMS.

We rated the following names as synonyms:

All the Year Round, Black Seeded Satisfaction and Salamander.
American Gathering, Prize Head, and Ferry's Early Prize Head.
Gray Seeded Butter and Frankfurt Head.
Hardy Green Winter and Hammersmith Hardy Green.
French Imperial Head and Large Princess Head.
Perpetual and Curled Simpson.
White Seeded Tennis Ball and White Forcing Head.
White Cabbage and Large White stone Summer.

CELERY.

In growing celery we made the experiment of planting one row of each so-called variety in a trench, one foot deep, well manured in the bottom with thoroughly rotted horse-manure, and a second row adjacent to the first on the level, without special manuring. Market gardeners have generally abandoned the practice of trenching the ground for celery. Whether the family gardener who grows but a small amount of celery can afford the extra expense of trenching and high manuring is the question which we hoped to answer in this experiment.

Our list included twenty named samples. One hundred seeds of each were planted in boxes April 11th and 12th, the latter being placed in a cold frame, where they were covered in severe weather.

July 5th sixty plants of each sample that vegetated so large a number were transplanted to the garden, thirty being set in a trench, and thirty on a level, as noted above, the rows being ten feet long. Where the samples failed to vegetate sixty plants, half of those that vegetated were set in each row. The data which we have noted are as follows:

CELERY.	Commenced to vegetate in — days.	Per cent vegetated.	Weight per hundred plants, level culture.	Weight per hundred plants trench culture.	Weight of bleached portion level culture (per plant).	Weight of bleached portion trench culture (per plant).	Average length of bleached stems, level culture.	Average length of bleached stems, trench culture.
					oz.	oz.		
Boston Market	28	78	157	157	9	9	12	12
Carter's Crimson	27	65	181	181	6⅛	6⅛	14	14
Crawford's Half Dwarf White	27	50	164	185	10	10	13	15
Dwarf Crimson	27	43	205	210	9¾	9¾	13	14
Golden Dwarf	27	70	125	139	5½	9	14	15
Giant White Solid	27	81	148	167	9⅛	6⅜	14	14
Golden Heart Half Dwarf	27	46	171	167	6⅜	10⅜	12	12
Half Dwarf	27	47	196	229	9¼	10¼	13	14
Laing's Mammoth Red	27	48	296	207	13¼	13¾	14	14
La Plume Chestnut	27	43	161	150	9⅛	8½	12	14
Major Clarke's Pink	26	59	160	171	10	10	14	14
Perfection Heartwell	26	65	122	153	12¾	17¼	14	14
Sandringham Dwarf White	26	59	173	125	9¾	9¾	15	15
Seymour's Solid Red	26	16	375	250	13	15⅛	15	15
Seymour's Solid White	26	33	218	215	......	3¾	14	18
Sutton's Sulham Prize	26	72	161	188	8	13	13	15
Turner's Dwarf White	26	72	119	229	7½	18⅛	14	16
White Walnut	26	78	134	135	......	......	14	16
Celeriac	26	53	93	119	......	.	......	....
Celariac — Apple	26	52	34	34	......	......	......	....

Unfortunately for our experiment, severe rains followed the transplanting, which filled many of the trenches with water, thus placing the plants set there at some disadvantage. In four of the cases in which the yield from the trench falls behind that from the level culture, viz.: Long's Mammoth Red, La Plume Chestnut, Sandringham Dwarf White and Seymour's Solid Red, our notes show that a large mortality of plants resulted from the flooding of the trenches. The same was the case, however, in Carter's Half Dwarf, Major Clark's Pink, Perfection Heartwell and Turner's Dwarf White, yet these varieties show a larger weight of plant in the trench culture. We cannot therefore assign the cases where the yield from the trenches was inferior to the damage from water, although from the lay of the land some trenches were more flooded than others.

Averaging our results obtained in seventeen samples in which the weights from the two rows are noted separately, we find that omitting fractions, plants grown in level culture averaged 177 pounds per hundred, while those in trench culture averaged 178 pounds per hundred plants.

It appears that in this experiment the trench culture yielded no return for the increased labor and manuring. It appears, however, that the length of the bleached stems was rather greater in the trench than in the level culture. We noted also that suckers were more numerous on plants grown in trenches, and that the base of the stems was more often split and deformed.

Suckers seem to be largely a variety characteristic, although no varieties are entirely without them. On the Boston Market, Sandringham Dwarf White, Seymour's Solid Red and Turner's Dwarf White, they were very numerous, while on Sutton's Sulham Prize they were quite rare.

The resemblance between many of the samples is very great. It seems probable that a more thorough acquaintance with them will discover many synonyms.

We weighed the blanched portion of four plants of seventeen varieties. In twelve of these the weights of each row is given separately. The figures presented are the average of the four plants. It is probable, however, that the number weighed was too small to furnish a correct average for the varieties, and hence we offer no deductions.

EGG-PLANT.

We planted seeds of egg-plant from sixteen named packages in the green-house April 6th. When of sufficient size a few plants of each lot were transplanted to the garden. The samples planted were named as follows: Black Pekin, Extra Early Dwarf Purple, Early Long Purple, Guadaloupe Striped, Ferry's Improved Large Purple, Long Purple, Round Purple, Scarlet Chinese, Scarlet Fruited, Tomato Formed Red, Tomato Shaped Red, White, Round White, White Long Chinese, Long White China and Yellow. The fruits of the Extra Early Dwarf Purple were fit for use several days earlier than those of any other variety. Ferry's Improved Large Purple bears a striking resemblance to the New York Improved which we grew last season, and both are closely allied to the round purple. As grown by us the Tomato Formed Red, Tomato Shaped Red and Scarlet Chinese were undoubtedly synonyms, as were also the White Long Chinese and Long White China. The white varieties are interesting, but are not seemed for culinary purposes.

PEPPERS.

We planted 100 seeds from each of nineteen named packages in boxes in the greenhouse April 9th and 12th. Six plants of each sample were transplanted to the garden May 24.

We have noted the following statistics:

NAME.	Commenced to vegetate in — days.	Per cent vegetated.	First flower in — days.	First ripe fruit in — days.
Cayenne "True"	10	45	87	136
Long Red Cayenne	10	92	82	136
Long Yellow Cayenne	10	82	91	136
New Cranberry	10	92	85	136
Small Red Chili	10	86	87	136
Cherry Red	10	94	102	130
New Oxheart	11	55	75	133
Oxheart	10	70	87	136
Long Red	8	23	82	136
Sweet Golden Dawn	10	94	89	140
Sweet Spanish	8	92	91	148
Spanish Monstrous	10	54	105	....
Squash, or Tomato Shaped	11	48	98	..
Large Squash	11	53	84	134
Sweet Mountain or Mammoth	8	17	80	137
Large Bell or Bull Nose	10	39	84	137
Orange Bell	11	92	88	148
Giant Emperor	11	89	94	159
Violet	12	60	107	137

The three samples called "Cayenne" are misnomers, as the Cayenne pepper, *Capsicum frutescens*, is a distinct species from the common garden pepper, being a perennial, with a woody stem, and not sufficiently hardy to endure our climate. These are probably smaller forms of the Long Red and Long Yellow Peppers.*

The Large Bell or Bull Nose and Sweet Mountain or Mammoth, are regarded by Vilmorin as synonyms. We have been able to see no difference in them.

A variety planted under the name Monstrosum proved to be the Long Red, and one under the name Long Yellow was spurious, being of the form of the Orange Bell. The latter seems to be only a yellow form of the Large Bell or Bull Nose Pepper.

A variety planted under the name Sweet Spanish, was evidently spurious.

The "Large Squash," and "Squash or Tomato Shaped," were not perceptibly different, nor were the "Oxheart" and "New Oxheart."

TOMATO.

Our test included sixty-four named samples. With the exception of the last five named in the table, the seeds, one hundred of each kind, were planted in boxes in the green-house, April 9, 10 and 11. Four plants of each sample were transplanted to the garden May 24. The data noted are as follows:

NAME.	Commenced to vegetate — days.	Per cent vegetated.	Commenced to bloom in — days.	First ripe fruit in — days.	First ten ripe fruits in — days.	No. of decayed fruits on one plnt.
Acme	7	91	83	136	141	15
Alpha	7	90	74	126	135	11
Arlington	7	80	87	147	164	9
Blount's Champion Cluster	7	95	82	136	148	5
Boston Market	7	69	89	135	137	5
Broad Leaved Dwarf	7	92	103	147	166	6
Canada Victor	8	45	88	133	140	1
Conqueror	7	62	88	133	140	3
Early Conqueror	7	86	103	140	156	....
Cook's Favorite	7	87	87	143	164	8
Criterion	7	85	89	164	174	2
Currant	7	79	82	127	131	many.
Early Red Smooth	7	50	87	133	140	5
Early Round Red Smooth	7	84	70	135	138	1
Early York	7	45	88	138	143	80
Essex Early Hybrid	7	92	103	143	165	....
Extra Early Red	8	62	86	158	165	....
Feejee Island Red	6	82	88	164	170	3
General Grant	7	26	82	135	140	8
Golden Trophy	7	99	82	143	166	1
Great Chihuahua	7	85	89	148	164	25
Green Gage	7	90	70	112	143	4
Hathaway's Excelsior	7	55	93	148	159	2
Howard	6	99	93	148	158	5
Hubbard's Curled Leaf	6	42	83	136	140	18
Hundred Day	6	93	70	129	143	4
Imperial Large Yellow	7	87	104	164	174	....
Keyes' Early Prolific	6	67	72	134	144	7
Large Red	6	88	83	136	140	9

* See *Les Plantes Potageres*, Vilmorin, p. 409.

NAME.	Commenced to vegetate in — days.	Per cent vegetated.	Commenced to bloom in — days.	First ripe fruit in — days.	First ten ripe fruits in — days.	No. of decayed fruits on one plnt.
Large Red Round Smooth	6	71	78	138	143	8
Little Gem	7	56	61	128	136	86
Livingston's Favorite	6	92	86	142	162	11
Livingston's Perfection	6	90	84	137	156	4
Lyman's Mammoth Cluster	7	84	88	156	164	4
Mayflower	8	85	72	143	170	5
French Upright	9	48	104	182	*	2
New Japanese	7	72	82	143	187	6
New White Apple	7	94	82	143	148	6
Orangefield	6	97	81	135	143	6
Painted	7	89	83	164	174	2
Paragon	7	91	86	166	*	3
Pear	6	95	63	143	147	10
Powell's	9	64	87	136	159	3
President Garfield	9	88	77	*	*	3
Reade's Island Beauty	9	90	67	130	143	11
Red Chief	7	83	73	136	148	4
Red, from South America	9	87	73	140	143	5
Red Valencia Cluster	9	74	89	144	159	5
Rochester	6	20	82	143	169	8
Tilden's New	9	26	86	140	147	10
Triumph	6	75	78	133	147	7
Trophy	6	95	65	143	144	2
Trophy, "Extra Selected"	6	89	83	147	174	....
Turk's Cap, or Turban	6	82	63	131	135	10
White, from South America	6	100	71	140	148	....
Yellow Cherry	8	14	63	131	134	many.
Yellow Fig	8	41	65	138	143	....
Yellow, from South America	8	82	63	133	136	many.
Yellow Plum	6	99	63	131	136	many.
Yellow Victor	8	43	82	134	136	12
"No Name"	14	32	78	133	136	14
Horsford's No. O	16	52	80	134	*	4
Horsford's Cross (Acme and Trophy)	16	82	80	119	*	1
Seedless	12	39	62	*	...	....
Mammoth California	12	70	68	*	....	....
Physalis (Alkekengi)	....	....	....	....	...	...
Strawberry or Ground Cherry Tomato	...	....	....	....	....	....
Sweet Mexican Tomato	11	79	65	....	....	....
Small Yellow Alkekengi	18	95	121	*	....	....

We note the date at which the first ten fruits were ripe to show the time when the fruits of the different varieties were available for table use. The first tomato to ripen was of the Green Gage variety, and was noted July 31st or 112 days from planting. The first large fruited variety that ripened ten fruits was the Alpha, the time of which was noted August 22nd or 135 days from planting. The New Currant, a very small variety, had ripened ten fruits on August 18th and the Turk's Cap, also a small variety, August 22nd. The President Garfield, a so-called new variety, failed to ripen a fruit.

We find that the order of the ripening of the varieties does not agree with that noted last season. Thus, last year the Acme was two days later than the Mayflower; the past season it was seven days earlier. Last year the Acme was six days earlier than the Paragon; the past season it was thirty days earlier. Last year the Acme and Trophy ripened the same day, the past season the Acme was seven days earlier

* Failed to ripen.

than one sample of the Trophy, and eleven days earlier than the other.

We noted the fact that as the rule, smooth tomatoes have few cells, and conversely, that many-celled tomatoes are rough. The number of cells often varies in the fruits on the same plant, as does also the smoothness of the fruits. These facts suggest that in order to secure smooth fruit we should select for seed those which have few cells. As evidence in favor of this suggestion, we note that fruits of the Acme tomato are invariably smooth, and the number of cells in this variety rarely exceed four. The Cherry, the Currant and Apple tomatoes are also invariably smooth and rarely have more than two cells.

September 29th we carefully counted the number of fruits that were affected with the tomato rot, on one plant of each so-called variety. The results obtained are noted in the right hand column of the table. It is not supposed that one plant will show the actual relative amount of decay in the different varieties, though we think the figures represent a fair index of it. A few varieties are noted as showing no decayed fruits. We found, however, upon careful examination of all of the plants of these varieties that an occasional affected fruit appeared. Even those varieties that seemed rot-proof last year were more or less affected.

We noted during the latter part of the season that the foliage of the tomato plants was attacked by a blight or mildew. In general terms, the amount of this blight was proportionate to the amount of decay. Thus, the leaves of the Early York, Great Chihuahua, and Little Gem varieties, were much blighted, especially those of the Great Chihuahua.

The fruits of the tomato vary so much, that the study of synonyms is extremely difficult. We found the President Garfield and Great Chihuahua exactly similar in appearance, though the latter proved several days earlier than the former. The same may be said of the Acme and Essex Early Hybrid. The seeds planted under the names Early Red Smooth, Early Round Red Smooth, Extra Early Red, Large Red and Large Red Smooth Round, show very slight differences in appearance or time of maturity, and are probably but one variety. The limit of variation is so broad, that one season's study is not sufficient to determine the synonyms.

As will appear from the table, we also grew three varieties, or, more accurately, three species of Alkekengi or Strawberry Tomato. Strictly speaking, these are not tomatoes at all, as they belong to a different botanical genus from the tomato. The small globular fruits are inclosed in a peculiar thin membranous, inflated, angular covering, which is the expanded calyx of the flower. The plants which are sometimes found growing wild, are low, very spreading and exceedingly prolific.

The fruits are known under various names, as Strawberry Tomato, Winter Cherry, Ground Cherry, Barbadoes Gooseberry, Mexican Tomato, etc.

The three species grown were identified as *Physalis edulis, P. Philadelphicum* and *P. viscosa.*

THE PEA.

Our trial list of peas embraced seventy so called varieties. The first planting of sixty-eight named samples was made April 21. One hundred seeds of each (with a few exceptions), were planted in rows ten feet long and three and one-half feet apart. The seeds were planted two inches deep, and were placed in the row as nearly equi-distant as possible, which made them on the average one and two-tenths inches apart. The soil was rolled after planting, and during the season was cultivated only sufficiently to keep down weeds. The plants were not thinned, and only the taller varieties were bushed. The more important data noted are condensed in the following table, in which the names of the wrinkled sorts are printed in italics. In order to avoid decimals we have calculated the pods per plant and the peas per pod on the basis of 100.

PEA.

VARIETY.*	Date planted.	Commenced vegetation in —— days	Per cent vegetated.	Bloomed in —— days.	First edible maturity in —— days.	Days fit for table use.	First pods ripe in —— days.	Last pods ripe in —— days.	Number of pods per 100 plants.	Number of peas in 100 average pods.	Average yield of ripe peas per plant in grs.
American Wonder	April 21	18	68	48	64	11	80	87	300	407	44
Bishop's Dwarf Prolific	April 21	17	68	52	74	13	88	101	1,218	464	189
Bishop's Long Pod	April 21	17	69	49	74	13	38	102	685	337	149
Black-eyed Marrowfat	April 21	18	67	62	77	21	91	114	1,066	360	272
Blue Imperial	April 21	17	26	58	79	12	93	114	2,070	395	446
Blue Imperial Dwarf	April 21	17	33	58	77	10	93	110	1,506	364	346
Blue Peter	April 21	18	55	49	64	16	79	88	402	415	581
British Queen	April 21	18	40	58	77	18	93	116	2,344	322	425
Brown's New Dwf. Marrowfat.	April 21	19	22	64	77	14	94	116	1,562	688	493
Caractacus	April 21	18	68	48	67	21	86	101	991	540	191
Carter's Challenger	April 21	16	53	57	74	14	87	105	642	507	222
Carters Commander in Chief	April 21	16	62	52	73	22	86	116	1,150	544	249
Carter's First Crop.	April 21	17	80	47	63	17	79	86	450	481	76
Carter's Little Wonder	April 21	17	21	60	80	26	98	122	1,706	500	425
Carter's Premium Gem	April 21	17	27	49	64	16	86	124	644	378	121
Carter's Pride of the Market	April 21	18	61	59	76	15	94	121	531	552	151
Champion of England	April 21	17	61	56	75	20	89	115	1,644	376	267
Culverwell's Telegraph	April 21	17	39	57	74	15	87	109	930	602	307
Daniel O'Rourke	April 21	17	81	48	63	26	79	195	900	459	249
Day's Early Sunrise	April 21	17	54	49	71	17	87	109	1,081	320	171
Doctor McLean	April 21	16	50	58	76	20	87	109	1,133	592	302
Dwarf Champion	April 21	17	36	50	69	22	88	101	....	525	....
Earliest of All	April 21	17	65	47	61	14	80	86	535	522	79
Early Alpha	April 21	16	50	48	63	9	86	102	923	423	138
Eugenia	April 21	17	46	49	71	20	90	110	1,286	313	193
Extra Early Kent	April 21	17	75	48	63	20	79	102	861	430	118
Ferry's Extra Early	April 21	17	66	48	62	13	79	84	366	449	59
Fillbasket	April 21	28	2	65	80	14	102	107	1,400	604	139
Thorburn's First and Best	April 21	17	81	48	62	13	79	84	429	482	66
Ferry's First and Best	April 21	17	76	47	62	13	79	84	424	467	68
Cleveland's First and Best	April 21	16	78	48	62	13	79	86	417	500	79
Sibley's First and Best.	April 21	16	70	47	63	12	79	86	433	408	57
Henderson's First of All	April 21	16	73	48	62	13	79	86	449	459	73
Hair's Dwarf Green Marrow	April 21	17	23	59	76	16	94	107	1,441	288	276
Hancock	April 21	18	71	48	62	13	89	86	487	458	85
John Bull	April 21	16	29	60	79	19	97	121	1,300	540	303
Kentish Invicta	April 21	16	60	47	62	21	86	95	736	432	109
Laxton's Long Pod	April 21	16	64	52	75	17	88	105	1,415	554	281
Laxton's Marvel	April 21	18	40	60	77	18	91	109	932	624	247
Laxton's Omega	April 21	19	4	65	86	......	105	114	1,200	240	113
Laxton's Supreme	April 21	17	33	57	76	21	93	114	1,437	504	313
M rket Garden	April 21	17	43	50	71	24	89	102	1,394	364	178
McLean's Advancer	April 21	17	62	55	74	14	87	102	1,164	536	213
McLean's L. Gem	April 21	17	41	50	67	14	84	98	....	346	128
McLean's Premier	April 21	18	17	62	72	33	95	110	4,637	376	698
Minimum	April 21	17	44	50	65	15	80	90	548	429	48
Napoleon	April 21	16	56	52	74	15	87	107	1,605	472	187
Philadelphia Extra Early	April 21	18	68	48	64	16	80	86	514	417	83
Prize Taker Gr. Marrow	April 21	17	27	56	75	28	87	109	1,687	579	412
Premium Gem	April 21	17	18	49	65	15	80	95	940	373	130
Royal Dwarf Marrowfat	April 21	17	38	67	77	18	93	109	1,512	480	425
Strategem	April 21	19	11	60	77	18	102	110	1,050	452	256
Telephone	April 21	17	22	57	74	15	87	109	1,133	599	354
The Racket	April 21	18	29	49	70	29	86	117	....	......	....
Tom Thumb	April 21	16	64	52	76	30	91	117	....	......	....
Veitche's Perfection	April 21	16	32	59	86	20	100	121	2,994	384	517
White Marrowfat	April 21	17	58	62	77	12	91	109	918	516	318
William the First	April 21	16	59	48	67	21	80	102	1,489	413	210
Yorkshire Hero,	April 21	16	24	59	80	14	98	114	1,784	320	359
Dwarf Gray Sugar	April 21	17	88	57	74	14	13	96	981	593	138
Dwarf White Sugar	April 21	16	57	52	74	21	20	109	1,738	489	270
Fall Sugar	April 21	16	85	58	79	26	96	115	1,441	428	254
Fall Gray Sugar	April 21	16	89	58	74	21	90	109	616	457	116
Wrinkled Sugar	April 21	16	74	58	77	29	98	112	1,355	428	208

* Wrinkled sorts in italics.

From the results noted in the table it appears that the pods of Laxton's Earliest of All was earliest, furnishing peas fit for table use in 61 days, and that those of Laxton's Omega and Veitch's Perfection were latest, being fit for the table in eighty-six days. McLean's Premier continued fit for table use during thirty-three days, the longest time noted, while those of Early Alpha were fit for use but nine days.

Ferry's Extra Early, Thorburn's First and Best and Ferry's First and Best ripened their entire crop in eighty-four days from planting, while Carter's Little Wonder required 122 days to ripen its latest pods. McLean's Premier was most prolific both in pods and peas, yielding 4,637 pods on 100 plants, and averaging 698 grains of ripe peas per plant. The American Wonder was least prolific, yielding but 300 pods on 100 plants, and averaging but forty-four grains of ripe peas per plant. We should state in justice to the latter variety that it was the most dwarf of any tested, the "Minimum" excepted, which accounts for its light yield. Were the rows planted as closely as the height would admit, the yield upon a given area would probably not be less than in other varieties of equal earliness.

Brown's New Dwarf Early Marrowfat contained the largest number of peas to the pod, and Hair's Dwarf Green Marrow the smallest.

Seeds of two wrinkled varieties were sent us for trial by Messrs. B. K. Bliss & Sons of New York, under the names "A. No. 1," and "A. No. 2." We have not reported them, as but one plant of each variety vegetated.

Seeds of three varieties from Japan were sent to us by Messrs. Hiram Sibley & Co., under the names "Bari," "Narosis" and "Volo." The first two failed, of the third, two seeds vegetated. The plants were of a distinct species from the common garden pea; and in appearence resembled the vetch. They were identified as the Chick Pea, *Cicer arietinum, L.*

On May 12th we made a second planting, sixty-three so-called varieties, of which fifty-eight were duplicates of the first planting. Comparing the results of the two planting, we find differences which we cannot explain. We note, for example, that the second planting showed a decidedly smaller percentage of vegetation than did the first, although the seed was in most cases taken from the same packages. This variance, which was far from uniform in the different varieties, amounted upon the average to twenty-three per cent., although two varieties vegetated better in the second planting than in the first.

We find that the order of the edible maturity in the varieties of the two plantings does not entirely agree. Thus, of the second planting, Carter's First Crop, Daniel O'Rourke, Laxton's Earliest of All, Early Alpha, Cleveland's First and Best, Sibley's First and Best, Hancock and Philadelphia Extra Early, were all noted at edible maturity on June 30. On July 1, we noted American Wonder, Blue Peter, Henderson's First of All, Ferry's Extra Early, and Ferry's First and Best. Kentish Invicta was noted July 3.

The comparative results are condensed in the following table:

	Planted April 21. Edible.	Planted May 12. Edible.
Laxton's Earliest of All........................	June 21	June 30
Kentish Invicta........................ ...	June 22	July 3
Henderson's First of All........................	June 22	July 1
Ferry's Extra Early........................	June 22	Jnly 1
Thorburn's First and Best........................	June 22	....
Ferry's First and Best........................	June 22	July 1
Cleveland's First and Best........................	June 22	June 30
Hancock........................	June 22	June 30
Carter's First Crop........................	June 23	June 30
Daniel O'Rourke........................	June 23	June 30
Early Alpha........................	June 23	June 30
Extra Early Kent........................	June 23	July 7
Sibley's First and Best........................	June 23	July 30
American Wonder........................	June 24	July 1
Blue Peter........................	June 24	July 1
Carter's Premium Gem........................	June 24	July 5
Philadelphia Extra Early........................	June 24	June 30

We note that twenty-one days' earlier planting was followed by an earlier edible maturity of from six to fourteen days in the different varieties.

Averaging the periods between and edible maturity in the two plantings, the order of earliness is as follows: Laxton's Earliest of All had pods fit for the table in fifty-five days; Cleveland's First and Best, and Hancock, in fifty-five and one-half days; Henderson's First of All, Ferry's Extra Early, Ferry's First and Best, Carter's First Crop, Daniel O'Rourke, Early Alpha and Sibley's First and Best in fifty-six days; Philadelphia Extra Early in fifty-six and one-half days; Kentish Invicta, American Wonder and Blue Peter in fifty-seven days, Carter's Premium Gem fifty-nine days, and Extra Early Kent in fifty-nine and one-half days.

In the yield of pods per plant we find a very striking difference between the two plantings. Thirty-three varieties, of which the comparative yields were noted, yielded ninety-four per cent, more in the second than in the first planting. Here too we find a lack of uniformity which is perplexing. The Kentish Invicta, British Queen, Prize Taker, Green Marrow, and White Marrowfat produced more than three times as many pods per plant in the second as in the first planting, while Day's Early Sunrise and Veitch's Perfection produced considerably less in the second than in the first.

As the per cent of vegetation in the second planting was fifteen per cent smaller than in the first, we might expect a larger yield per plant, owing to the greater distance between the plants. But this fails to account for all the difference in prolificacy, for Day's Early Sunrise, with twenty per cent less vegetation in the second planting, yielded about sixteen per cent fewer pods to the plant.

In the number of peas in the pod, it appears that in twenty-four varieties it was larger in the second planting, while in ten it was smaller. The Prizetaker Green Marrow, which produced a much

larger yield of pods in the second planting than in the first, had about two peas less in the pods, while the Kentish Invicta, with about the same surplus of pods, gave one and one-half more peas to the pod.

While we note there is a variety difference which is well marked, yet we cannot fail to perceive that no one planting is sufficient to furnish data from which we may safely generalize as to the permanent differences and qualities between the various sorts.

SYNONYMS.

A careful observation leads us to believe that seven catalogue varieties of peas are, in reality, but one and the same variety. We present an abstract of our notes in tabular form so that the reader may examine the evidence and corroborate our opinion. The seed planted of these seven names was obtained from six different sources; and with the exception of two of the samples were of unknown age and history. Had we known them to be of the same variety, we could hardly have expected more uniform results. Reference to our experiment with early and late pods from the same variety will show that a difference in earliness of five days resulted from the selection of pods; while our experiment with well and poorly filled pods showed a difference in the yield of almost five hundred pods in 100 plants. If such differences are possible in seed known to be of the same variety and to have been grown under like conditions, it is not surprising that the slight difference noted in the table should have appeared in the results from seven different samples of seed. We have reliable testimony that the character of the soil may have an influence upon the growth of the pea plant that will extend through more than one generation. This might readily account for the fact that the vines of Henderson's First of All were slightly more dwarf than in the other samples.

The descriptive notes in the column for remarks are so nearly alike in the different plantings, that one sample answers for all.

Our notes also indicate that the peas known as Day's Early Sunrise and Eugenia have a very striking similarity, the only difference being that the latter was slightly more prolific.

The Blue Imperial and Dwarf Blue Imperial are unquestionably identical, as are also Carter's Premium Gem and Premium Gem. We have indications that some other names are synonyms, but we shall await further trial before decision.

VARIETY.	Planted.	Vegetated.	Bloomed.	First edible maturity.	Last edible maturity.	First ripe seed.	Last ripe seed.	No. of pods per hundred plants.	No. of peas per hundred pods.	Distance between nodes.	Length of peduncles.	Size of largest leaflets.	Size of larger stipules.	Height of plant.	Remarks.
										inch.	inch.	inch	inch.	feet.	
Cleveland's First and Best	April 21	May 7	June 8	June 22	July 4	July 9	July 16	500	417	2-3	1-2	1x1½	1½x2	2	Foliage rather scanty, light green, stem glaucous; stem slender, often branched at base; stipules marked with grayish white, pods usually single.
Ferry's First and Best	April 21	May 8	June 7	June 22	July 4	July 9	July 14	467	424	2-3	1-2	1½x1¾	1¾x2	2x2½	" "
Sibley's First and Best	April 21	May 7	June 7	June 23	July 4	July 9	July 16	408	433	2-3	½-2	1x1½	1½x2	2	" "
Thorburn's First and Best	April 21	May 8	June 8	June 22	July 4	July 9	July 14	482	429	2-3	1-2	1x1½	1½x2	2	" "
Henderson's First of All	April 21	May 7	June 8	June 22	July 4	July 9	July 16	459	449	2-3	1-2	1x1½	1x2	1½	" "
Hancock	April 21	May 8	June 8	June 22	July 4	July 9	July 16	458	487	2-3	½-2	1x1½	1½x2	2	" "
Philadelphia Extra Early	April 21	May 9	June 8	June 24	July 9	July 10	July 16	514	417	2-3	1-2	1x1½	1½x2	2	" "

VARIETY.	Planted.	Vegetated.	Bloomed.	First edible maturity.	Last edible maturity.	First ripe seed.	Last ripe seed.
Cleveland's First and Best.	May 12	May 25	June 15	June 30	July 10	July 14	July 26
Ferry's First and Best.....	May 12	May 25	June 15	July 1	July 12	July 16	July 26
Sibley's First and Best....	May 12	May 25	June 16	June 30	July 10	July 14	July 25
Thorburn's First and Best.	May 12	May 25	June 15	June 27	July 12	July 14	July 26
Henderson's First of All...	May 12	May 25	June 16	July 1	July 10	July 14	July 26
Hancock	May 12	May 25	June 15	June 30	July 10	July 14	July 27
Philadelphia Extra Early..	May 12	May 25	June 15	June 30	July 11	July 14	July 26

VARIETY.	Planted.	Vegetated.	Bloomed.	First edible maturity.	Last edible maturity.	First ripe seed.	Last ripe seed.	Number of pods per hundred plants.	Number of peas per hundred pods.	Distance between nodes.	Length of peduncle.	Size of larger leaflets.	Size of larger stipules.	Height of plant.	Remarks.
Day's Early Sunrise.......	April 21	May 8	June 9	July 1	July 17	July 17	Aug. 8	1,081	320	in. 2-3	in. 1-2	in. 1¼x1¾	in. 1½x2½	ft. 2½	Foliage rather deep green; stem r'th'r stocky sometimes branched at the base pods usually in pairs, not well filled.
Eugenia	April 21	May 8	June 9	July 1	July 20	July 20	Aug. 9	1,286	313	2-3	¾-2	1¼x2	2x3	2½	
Day's Early Sunrise.......	May 12	May 22	June 17	July 9	Aug. 7	Aug. 4	Aug. 16	933	372						Foliage deep green, stem often branched at the base; pods frequently in pairs not well filled.
Eugenia.......	May 12	May 25	June 17	July 7	Aug. 8	July 26	Aug. 20	2,004	316						

EXPERIMENTS.

In order to ascertain how much may be gained in the earliness of peas by selecting the earliest pods for seed, we gathered last season the earliest and the latest ripening pods from a row of the Tom Thumb pea. One hundred seeds of each of these selections were planted April 21, under the conditions noted for the test of varieties, and a duplicate planting was made May 12. The results were as follows:

PEAS FROM	Planted.	Per cent vegetated.	Fit for table in — days.	No. of pods per hundred plts.	No. peas per hundred pods.
Earliest pods	April 21	99	68	680	420
Latest pods	April 21	83	74	777	455
Earliest pods	May 12	70	56	2,083	463
Latest pods	May 12	67	60	1,386	311

It thus appears that the earlier ripening peas vegetated better in both cases, the difference amounting in the average to 14½ per cent. They were also fit for the table earlier by an average of five days. The other figures are somewhat confusing. Taking the average of the two plantings, however, we find a difference in favor of the early pods of 2.25 pods per plant, and of .615 peas per pod. This difference was more noticeable while the plants were growing than after they had ripened their crop. Thus, on July 14, we noted that in the planting of April 21 ten plants from the earliest ripened seed had produced sixty-eight pods, of which thirty-eight were well filled, while an equal number of plants from the latest ripened seeds had produced only forty-nine pods, of which but thirteen could be called well filled.

The Tom Thumb variety was selected for this trial because the pods are formed during a longer period than in most other varieties. It is probable that in varieties of which the pods nearly all ripen at the same time, the difference from the results obtainable from the first and last ripened pods would be less marked.

In order to ascertain how far well-filled pods are superior for seed to those poorly filled, we gathered last season the very best filled pods of two varieties of pea, and also a few pods that contained only one or two seeds each. The varieties were Laxton's Marvel and Culverwell's Telegraph. The peas from the best filled pods, from the poorest filled pods and from well-filled pods were planted April 21 in adjoining rows, with the following results:

CULVERWELL'S TELEGRAPH.	Per cent vegetated.	No. of pods per hundred plts.	No. of peas per hundred pods.
Pods containing one or two peas	15.22	1,586	537
Pods containing eight peas	8.	1,100	503
Pods containing ten peas	9.26	2,150	549
LAXTON'S MARVEL.			
Pods containing one or two peas	41.46	1,449	475
Pods containing nine peas	23.	1,762	518
Pods containing eleven peas	54.55	1,946	581

In the case of Culverwell's Telegraph the row from the pods that contained eight peas gives inferior results in every case. We make no attempt to account for this. The row from the pods that contained ten peas show, however, a considerable improvement over the one from the pods that contained but one or two peas. In the Laxton's Marvel there is a gradation in the numbe. and length of the pods from the seed from the poorest filled to that from the best filled pods.

We also noted that the pods that contained the maximum number of peas were from the seed from the best filled pods. Thus, in the Laxton's Marvel, the plants from the nine-seeded pods produced three pods that contained ten peas each, but none that contained a larger number, while the plants from the eleven-seeded pods produced ten pods that contained ten peas each and two that contained eleven each.

We noted, also, in the case of the Laxton's Marvel, that while the plants from seed from the best filled pods were remarkably uniform in height, productiveness and maturing, those from the seed of the poorest filled showed much irregularity. Several of the plants were what seed growers term "runners," growing much taller than the others, producing very inferior pods and ripening much later.

In order to note the influence of distance in planting upon the number and length of the pods produced, we made on May 12, six plantings of the Eugenia pea, at different distances apart. The results were as follows, the distances noted in the table being the actual average distance between the plants that vegetated in the various rows:

No. plants.	Aver. distance apart.	No. pods per hundred plants (cal.)	No. of peas per hundred pods.	No. of pods in 10 feet.
12	20 inches	3,992	442	239
32	$7\frac{1}{2}$ inches	2,562	422	410
19	$6\frac{1}{3}$ inches	2,721	368	517
23	$5\frac{1}{5}$ inches	2,004	316	461
38	$3\frac{1}{6}$ inches	1,321	372	502
48	$2\frac{1}{2}$ inches	1,462	300	702

It thus appears that for the full development of the individual plant a distance between the plants of more than seven and one-half inches is necessary, but a distance of two and one half inches apart gives a larger yield from the same length of row than more distant planting. It also appears that the length of pod is greater in remote than in closer planting.

In order to note the effect of different depths in planting upon the percentage of vegetation, we planted on May 12, an equal number of Eugenia peas at a depth of one-fourth inch, one inch and two inches, respectively.

Those planted one-fourth inch deep vegetated eighty-nine and one-half per cent, those planted one inch deep vegetated seventy-nine per cent, while those planted two inches deep vegetated only forty-three and three-fourths per cent. The time required for vegetation was shortest in the shallow planting.

The pea will germinate when gathered very green. About August 1, we planted seeds of the pea which were gathered when about half grown, others that were of proper size for table use, others that had

commenced to harden, and others still that were fully ripe. All of these plantings vegetated fairly well. The greenest ones, however, showed a rather smaller percentage of vegetation than the other samples. October 16, we noted that the plants from the seeds that were too hard for table use, but not fully ripe, had made the largest growth.

We made the experiment of planting peas very late to see if they would thus escape the attack of the pea-weevil, *Bruchus pisi*. We planted June 6, two short rows each of the William the First and Premium Gem varieties. The plants escaped the mildew better than we had anticipated, and matured a fair crop of peas. The yield was a little less, and the ripe seed a little more shrivelled than in our earlier planting of the same varieties. At date, December 11, these peas show very few signs of containing weevils, although the seed of the same varieties from the early plantings is already swarming with this insect.

We also repeated our experiment of last year, confining a small quantity of bisulphide of carbon in a bottle filled with peas, in which the weevils were not yet sufficiently developed to be apparent on the outside. The result was the same as last year,— no weevils have developed at date, December 11. About forty per cent of the peas of the same variety that were not thus treated, have either full grown weevils in them, or the cavities whence they have come out.

It would seem that this method of treating peas might be useful to those who grow them for seed. While we have had no experience in its application on a commercial scale, we see nothing to prevent such a use of it. If, as soon as the peas are suffiiciently dry for sacking, they were headed up for a fortnight in tight barrels or bins, into each of which was poured a pint or two of bisulphide of carbon, it is very doubtful if a weevil would ever emerge from them. In our experiments, we found that this liquid prevented the growth of fungi in the pea, even when they were put up quite wet. Hence, there would be little if any danger of the pea heating in the barrels or bins to a degree sufficient to injure them. Our experiments indicate that their power of germination is not diminished by this treatment. It might be injured, however, if the peas were confined too long.

The grower of seed peas has the power to nip this evil in the bud, but so long as the public is willing to purchase and plant infested peas, we can hope for no relief.

Cross-fertilizing different varieties.

Last season we cross-fertilized the flowers of several different varieties of the pea, among them Day's Early Sunrise with Dwarf Gray Sugar, Champion of England with Culverwell's Telegraph, and Champion of England with American Wonder. The seeds resulting from these crosses, which were planted May 12, vegetated rather poorly, but the plants were all vigorous, and a few of them were very prolific, the largest yield from one plant being sixty-one pods. We noted that in crossing wrinkled with smooth varieties, peas of both sorts were mixed indiscriminately in the pods, while the pods themselves were of the type of either parent, or were sometimes intermediate in form; but in crossing the common varieties upon the sugar-pea, the

peas of the two types were in no case mixed in the pods. The pods were always of the type of the common pea, though on certain plants all of the peas that they inclosed were of the sugar type.

For the benefit of those who may desire to make experiments in cross-fertilization, we remark that the pistil of the pea is fertilized by its pollen before the flower expands. It is necessary, therefore, to remove the stamens before this time, to prevent self-fertilization. In our experiments we have noted that the fertilization takes place about the time that the pure white color appears in the petals. So long as the petals remain greenish, the flower is in condition for castration, but after the color has changed to white, it is useless to attempt cross-fertilization. We remove one or more of the petals with a pair of tweezers, which exposes to view the pistil, surrounded by the stamens. The anthers, which look like small yellow balls at the outer end of the stamens, are then picked off with the tweezers, taking care not to break or injure the pistil. After about twenty-four hours, a fully opened flower from the variety that is desired to cross with it is taken, and enough of the petals removed to expose the anthers. The pollen is now visible as a yellow dust, looking much like flowers of sulphur. A portion of this dust is placed upon the stigma (outer end of the pistil) of the castrated flower, either by the use of a small camel's hair brush or by touching the anthers themselves to the pistil. If this is well done, the pollen will be easily visible upon the stigma. We have found that when the foliage of the plants is wet, so that a small drop of water can be easily placed upon the stigma with the tweezers, before applying the pollen, the latter adheres better, and is less likely to be blown off by the wind before it is assimilated by the flower.

As the pollen of the pea is confined for a long time within the petals, is not much blown about by wind, and is very rarely carried by insects, it is hardly necessary to protect the castrated flowers by inclosing them in paper bags, as we are compelled to do in many other plants. It is very important, however, to tie a bit of some bright colored cord about the stem of the flower, so that it can be readily found again. We cannot be certain that the fertilization has taken place until the pod is formed and shows evidence that it contains peas. Pods will frequently form from cross-fertilized flowers that develop no peas.

Spinach.

We planted one hundred seeds each from eight named packages in the garden, April 30, in rows ten feet long and twenty-one inches apart. We have noted the following data:

NAME.	Commenced to vegetate in — days.	Per cent vegetated.	Fit for table use in — days.	First bloom in — days.	First ripe seed in — days.
Bloomsdale	11	73	42	41	78
Hortenso, from Japan	11	51	41	41	73
Long Standing	12	63	41	47	73
Prickly, or Winter	11	72	43	47	73
Round, or Summer	11	79	47	55	85
Savoy-Leaf	11	78	42	42	73
Thick-Leaved Round	11	71	42	51	78
Viroflay	11	63	41	44	78

The Viroflay was decidedly the most vigorous variety, while it was as early as any. The leaves grow very large, sometimes ten inches in length, and eight inches broad at the base. It is only on very fertile soil, however, that the plants attain their largest size.

The Long Standing was similar to the Viroflay, but of slightly smaller dimensions. The Hortenso, seeds of which were presented to the station by Messrs. Hiram Sibley & Co., did not appear to be adapted to our climate, at least not for spring sowing. The plants ran to seed before the leaves were of suitable size for table use.

We also grew the New Zealand Spinach, *Tetragonia expansa*, Ait., and two varieties of Orach, or French Spinach, *Atriplex hortensis, L.* Although usually called varieties of spinach, these plants belong to distinct genera from the common spinach.

The New Zealand Spinach is a low, annual plant, with spreading, branching stems, numerous thick, fleshy leaves, and greenish, inconspicuous axillary flowers, the leaves are used like those of common spinach, but develop later. Planted April 30, the leaves were fit for the table July 1, the plant bloomed July 16, and the first seeds were ripe September 14.

The Orach is a tall, annual plant, with numerous broad, slightly blistered, soft, arrow-shaped leaves, which are used like those of common spinach. The general appearance of the plant recalls that of the common pigweed. We grew two varieties, the Red and the White, which differ only in the color of their foliage. Planted April 30, the leaves were fit for the table June 14, the plant bloomed August 7, and the first seeds were ripe September 14.

PARSLEY.

One hundred seeds each from six named packages were planted in boxes in the greenhouse April 9th. We have had very poor success in growing this plant from seeds sown in the open ground, but in the greenhouse the seeds germinated as well as those of many other plants. The samples were named and vegetated as follows :

	Commenced to vegetate in — days.	Per cent vegetated.
Carter's New Fern Leaf	14	6
Double Curled	12	85
Hamburg	11	45
Moss-Curled	14	54
Triple Curled	14	63
Norway, from	..	53

A few plants of each variety were transplanted to the garden June 20.

The Carter's New Fern Leaf, Double Curled, Moss Curled and Triple Curled are very closely allied, the chief difference being in degree of fineness to which the leaves are cut, and the amount to which the segments are folded. As parsley is grown to some extent as an ornamental plant, these differences are legitimate variety characteristics so far as they are transmissible by seed.

The Hamburg and the variety from Norway, the latter a late introduction, presented to us by Messrs. Hiram Sibley & Co. of Rochester, are very distinct, from the others, as they have thickened tap-roots, which show a considerable regularity in shape, being in the finest samples as well formed as in the radish. The root of these varieties is the portion used, and it is eaten in the same manner as that of Celeriac or Turnip Rooted Celery, which it resembles in taste, though it is rather less delicate. The Hamburg parsley is considerably cultivated in Germany, where two so-called varieties of it are described. It is grown precisely like the parsnip. In this country, the roots should be taken up before the ground freezes and packed in earth or sand and stored in the cellar. The foliage of the thick-rooted varieties is exactly like that of the Plain-Leaved or common parsley, a variety formerly much grown in this country.

The thick-rooted parsley, like the Tuberous Rooted chervil, is a modern vegetable, having been introduced into culture at a comparatively recent period. These are striking examples of the influence of selection in changing the characters of plants. It is probable that among our uncultivated plants, especially the umbelliferous biennials, other roots might be obtained large enough for use as vegetables. The experiments of M. Louis Vilmorin, of Paris, confirm the truth of this statement. The *Anthriscus silvestris*, L., an umbelliferous plant which grows wild in the woods of France, after ten years of culture and systematic selection yielded half or more of its roots as simple, neat and conical in form as the finest samples of Hamburg parsley.

Herbs.

We planted seeds of fifteen species of the plants usually called by seedmen "herbs."

The names, date and manner of planting, with the other data noted, are as follows :

NAME.	Planted.		Commenced to vegetate in — days.	Per cent vegetated.	Bloomed in — days.	Seed ripe in — days.
Balm	May	1	...	....	....	.....
Basil (sweet)	May	1	17	19	88	.....
Borage	May	1	15	50	58	.....
Burnet	May	1	14	33	97	.....
Caraway	May	1	17	85	101	.....
Chervil	April	26	29	35	60	93
Coriander	May	1	23	12	73	136
Dill	May	1	15	48	73	.....
Horehound	May	1	34	1	....	.....
Hyssop	May	1	23	19	122	.....
Rue	May	2	22	35	....	.....
Sage	May	2	14	69	....	.....
Sorrel	May	2	13	27	99	.....
Sweet Fennel	May	2	9	48	87	.....
Thyme	May	2	22	7	....	.....

The Balm, Horehound, Rue, Sage and Thyme failed to bloom, and only Chervil and Coriander ripened seeds.

Borage, Chervil, Coriander and Dill are annual plants, and Basil and Caraway are biennials. The remainder are perennials.

The leaves of Balm, Basil, Horehound, Hyssop, Rue, Sage and Thyme are used as condiments, and the seeds of Caraway and Dill are used in the same way. Borage and Horehound are used chiefly as medicine. The leaves of Balm and the seeds of Coriander and Sweet Fennel are used in the manufacture of liquors; the leaves of Burnet and Chervil are used as salad; the leaves of Coriander are used for seasoning, and the seeds are used in a variety of culinary preparations.

MISCELLANEOUS VEGETABLES.

Besides the vegetables which we have already considered, we grew quite a large number of the rarer vegetables and novelties. These were planted for the purpose of procuring accurate descriptions of them, and as they are not of general interest, we do not present the same data that we have given for the more common vegetables, but simply note the list and number of varieties of each. These were: Cardoon, Collards, Corn Salad, Cress (three varieties), Endive (three varieties), Gobo (from Japan), Martynia, Mustard (three varieties), Okra (three varieties), Roquette, Scolymus and Whitloof.

The Gobo is of interest, as it is nothing more nor less than our Burdock changed somewhat by cultivation. In Japan the roots of this plant are used for food, being boiled or served in other ways. It

is said that if taken when about half grown they are tender and agreeable.

We had opportunity to test on the table the Green Globe Artichoke, a few plants of which were grown last year from seed. The plants do not yield a great amount of food, as only a portion of the flower head is used. This was pronounced very delicate and palatable.

Potato.

We planted in the garden twenty-two single eyes each (with a few exceptions) of ninety-two so-called varieties of potato, for the purpose of comparing their respective qualities, and also for the verification of an experiment made last season of cutting the eyes to different depths.

This number of eyes was taken because it best suited the length of our rows. The eyes were planted about two inches deep and one foot apart, on slight ridges, the centers of which were three and a half feet apart. The plants were not "hilled up," and were cultivated only sufficiently to keep down weeds.

The data noted as to yields, earliness, amount of decay, etc,, are condensed in the following table, in which the names are arranged alphabetically:

POTATO.	Date planted.	Date of first vegetation.	No. of eyes that vegetated.	Date of first bloom.	Date when tops were dead.	Calculated on Basis of one Hundred hills. No. of merchantable tubers.	No. of unmerchantable tubers.	Wt. of merchantable tubers.	Wt. of unmerchantable tubers.	No. of rotten tubers.	No. of malformed tubers.	Total number of tubers.	Total weight of tubers.
								lbs.	lbs.				lbs.
Adirondac	Apr. 30	May 28	22	July 4	Sep. 21	405	583	151	36	83	....	988	187
Alpha	Apr. 30	May 24	20	....	Aug. 25	122	183	14	1	6	22	305	15
American Giant	Apr. 30	May 28	21	July 6	Sep. 21	511	472	178	25	144	117	983	208
Andrus White Rose	Apr. 30	May 28	21	....	Sep. 3	305	789	75	41	58	32	1,094	116
Astonisher	Apr. 30	May 28	21	July 4	Sep. 21	130	600	38	32	....	60	730	70
Baker's Imperial	May 1	May 26	22	June 30	Sep. 21	329	100	113	53	71	67	429	166
Beauty of Hebron	Apr. 30	May 24	21	June 22	Sep. 14	541	1,724	150	57	288	192	2,265	207
Big Benefit	May 10	June 1	21	......	Sep. 14	185	1,305	47	55	310	....	1,490	102
Bliss' No. 12	May 1	May 28	21	July 4	Sep. 21	325	790	90	44	35	5	1,115	134
Bliss' No. 30	May 1	May 24	21	July 4	Sep. 21	167	1,438	45	61	88	19	1,605	106
Bliss' No. 39*	May 1	May 24	11	....	Sep. 14	110	730	22	31	....	...	840	53
Bliss' No. 51	May 1	May 24	22	....	Sep. 21	181	867	43	47	....	..	1,048	90
Bliss' Triumph	Apr. 30	May 28	21	....	Sep. 3	332	663	84	28		10	995	112
Boston Market	Apr. 30	May 24	22	June 25	Sep. 3	355	655	92	32	20	55	1,010	124
Breeses' Red	May 1	June 2	22	July 16	Oct. 8	310	543	118	34	43	5	853	152
Brownell's Best	Apr. 30	May 28	22	....	Sep. 14	355	1,080	88	46	195	5	1,430	134
Champion of America	Apr. 30	May 28	22	July 3	....	267	138	104	4	24	...	405	108
Chicago Market	Apr. 30	May 24	22	June 21	Sep. 14	338	657	104	41	176	105	995	145
Clarks' No. 1	Apr. 30	May 25	20	June 27	Sep. 14	389	621	134	36	106	84	1,010	170
Conqueror	Apr. 30	May 28	22	......	Sep. 21	352	876	103	39	90	33	1,228	142
Corless Matchless	Apr. 30	May 24	22	June 24	Sep. 21	333	871	96	48	129	57	1,204	144
Crandall's Seedling	Apr. 30	May 28	22	July 1	Sep. 21	480	490	145	34	10	50	920	179
Defiance	Apr. 30	May 24	20	June 30	Sep. 21	442	1,316	137	64	195	26	1,758	201
Duchess	May 10	June 4	22	....	Oct. 8	32	332	8	14	32	5	364	22
Dunmore	Apr. 30	May 28	21	......	Sep. 21	385	1,580	111	70	580	50	1,965	180
Early Electric	Apr. 30	May 25	21	July 1	Sep. 3	225	465	63	22	5	40	690	85

* Only eleven eyes planted.

POTATO.	Date planted.	Date of first vegetation.	No. of eyes that vegetated.	Date of first bloom.	Date when tops were dead.	Calculated on basis of one hundred hills. No. of merchantable tubers.	Number of unmerchantable tubers.	Wt. of merchantable tubers.	Wt. of unmerchantable tubers.	No of rotten tubers.	No. of malformed tubers.	Total number tubers.	Total weight of tubers.
								lbs.	lbs.				lbs.
Early Gem (Vick's)	April 30	May 24	22	June 24	Sept. 3	257	714	**71**	33	**14**	62	971	**104**
Early Harvest	April 30	May 24	22	June 21	Sept. 14	429	714	**106**	36	**5**	43	1,143	**142**
Early Household	April 30	May 24	22	....	Aug. 30	162	671	**37**	33	**29**	10	833	**70**
Early Mayflower	April 30	May 24	22	....	Sept. 1	400	848	**96**	44	**105**	10	1,248	**140**
Early Ohio	April 30	May 25	22	July 2	Sept. 3	229	462	**79**	24	**43**	33	691	**103**
Early Rose	May 1	May 28	22	June 29	Sept. 14	248	695	**71**	43	**81**	5	943	**114**
Early Snowflake	April 30	May 24	22	....	Sept. 3	367	1,029	**88**	47	**200**	14	1,396	**135**
Early Sunrise	April 30	May 24	22	June 24	Sept. 3	433	662	**90**	33	**43**	48	1,095	**123**
Early Telephone	April 30	May 24	22	....	Sept. 3	319	790	**82**	39	**295**	5	1,109	**121**
Early Vermont	April 30	May 24	22	June 26	Sept. 3	267	843	**81**	43	**448**	81	1,110	**124**
English Champion	April 30	May 24	20	....	Sept. 3	279	647	**81**	33	**253**	5	926	**114**
Farina	April 30	May 28	20	July 7	Sept. 14	332	621	**80**	37	**368**	16	953	**117**
First and Best	May 10	June 4	22	July 16	Sept. 21	214	357	**73**	23	**10**	57	571	**96**
Flesh Colored	May 1	May 29	22	....	Aug. 30	45	210	**8**	12	....	....	255	**20**
Garnet Chili	May 1	May 28	20	July 3	Sept. 21	220	325	**84**	21	**10**	130	545	**105**
Garfield	May 1	May 24	22	....	Sept. 3	371	690	**97**	43	**143**	10	1,061	**140**
Grange	May 1	May 24	22	July 9	Sept. 21	440	895	**161**	63	**375**	185	1,335	**224**
Gypsy	May 1	May 24	22	....	Sept. 21	533	1,000	**158**	48	**510**	81	1,533	**206**
Intermediate*	May 1	May 29	11	July 3	Sept. 14	170	270	**65**	21	**20**	60	440	**86**
Invincible	May 10	June 1	22	July 18	Sept. 21	290	1,119	**107**	52	**138**	33	1,409	**159**
James Vick	May 1	May 25	22	June 27	Sept. 21	414	1,052	**115**	45	**405**	76	1,466	**160**
Jordan Prolific	May 10	June 1	21	July 3	Sept. 21	140	720	**39**	32	**425**	30	860	**71**
Jumbo	May 10	June 1	22	July 3	Sept. 21	255	1,205	**72**	47	**200**	15	1,460	**119**
Knapp's Snowbank	May 1	May 25	22	....	Sept. 14	284	679	**90**	34	**416**	68	963	**124**
Late Beauty of Hebron	May 1	May 28	22	June 24	Sept. 21	300	790	**95**	48	**500**	100	1,090	**143**
Long Pink Eye	May 1	May 28	22	....	Sept. 14	75	295	**8**	19	**30**	0	370	**27**

Luxury	April 30	May 28	22	....	Sept. 3	375	1,380	108	70	45	180	1,755	178
Magnum Bonum	April 30	May 30	22	July 3	Sept. 14	325	295	125	17	90	105	620	142
Mammoth Pearl.	May 1	May 28	21	......	Sept. 21	343	971	115	45	252	48	1,314	160
Manhattan	May 1	May 28	22	....	Sept. 14	247	410	77	20	38	14	657	97
Marvel of Beauty	May 10	June 4	22	July 5	Sept. 3	224	1,023	82	52	410	5	1,247	184
McCormick	May 10	June 4	22	July 7	Oct. 16	366	743	124	47	....	5	1,109	171
Mountain Rose	May 1	May 28	21	....	Sept. 3	145	440	50	25	50	20	585	75
New Champion	May 1	May 28	22	June 30	Sept. 21	367	419	130	30	57	72	786	160
New England Beauty*	May 1	May 28	11	July 7	Sept. 21	470	690	149	31	60	....	1,160	170
New Sunrise	May 15	June 2	22	July 3	Sept. 14	190	1,052	55	42	343	33	1,242	97
Oneida Peachblow	May 9	May 31	15	July 12	Sept. 21	319	744	110	55	181	....	1,063	165
Pennsylvania Belle	May 1	May 28	22	July 4	Sept. 21	367	376	151	24	295	....	743	175
Pride of America	April 30	May 28	16	....	Sept. 3	218	623	56	35	123	....	841	91
Queen of the Valley	May 1	May 28	22	July 2	Sept. 21	352	110	168	10	129	....	462	178
Red Elephant	May 1	May 28	22	July 4	Sept. 21	357	486	124	24	178	38	843	148
Rochester Favorite	May 1	May 24	22	July 1	Sept. 14	376	409	141	28	100	129	785	169
Rocky Mountain Rose	May 1	May 31	22	July 3	Sept. 14	248	814	88	36	162	10	1,062	124
Rogers No. 4	May 10	May 28	20	....	Sept. 21	374	952	154	50	258	53	1,326	204
Rogers No. 7	May 1	May 28	22	July 4	Sept. 21	376	676	139	47	48	52	1,052	186
Rose's New Seeding	May 10	June 1	21	July 4	Sept. 21	170	940	43	45	320	....	1,110	88
Rosy Morn	May 1	May 28	21	June 30	Sept. 3	400	622	129	40	28	11	1,022	169
Rubicund	May 1	May 28	11	July 2	Sept. 21	382	578	162	31	15	27	950	193
Rural Blush	May 1	May 24	22	July 1	Sept. 21	495	333	154	26	5	5	828	180
Saint Patrick	May 1	May 28	22	July 16	Sept. 21	314	305	128	30	19	189	619	158
Scottish Champion	May 1	June 1	20	....	Oct. 8	155	900	36	39	...	....	1,055	75
Seeding from C. Baldridge	May 1	May 24	22	July 18	Sept. 21	224	209	80	14	....	10	433	94
Steele's Red	May 1	June 1	22	....	Oct. 8	314	547	96	35	52	24	861	131
Strong's Imperial	May 1	June 1	22	....	Sept. 14	214	347	71	23	33	24	561	94
Sunrise	May 15	June 9	22	July 5	Sept. 21	129	1,124	40	52	710	33	1,153	92
Tennessee Early Crop	May 1	May 24	22	June 28	Sept. 21	275	1,420	88	86	350	15	1,695	174
Tennessee Late Crop	May 1	May 24	22	June 27	Sept. 21	314	981	110	52	316	52	1,295	162
Tyrian Purple	May 1	May 28	21	....	Sept. 3	325	595	65	41	40	5	920	106
Vermont Champion	May 1	May 28	22	June 20	Aug. 30	200	129	47	11	....	....	329	58
Vick's Prize	May 1	May 28	22	....	Sept. 3	252	700	92	40	19	14	952	132

* Only 15 eyes planted.

POTATO.	Date planted.	Date of first vegetation.	No. of eyes that vegetated.	Date of first bloom.	Date when tops were dead.	Calculated on basis of 100 hills. No. of merchantable tubers.	No. of unmerch'table tubers.	Wt. of merchantable tubers.	Wt. of unmerch'table tubers.	No. of rotten tubers.	No. of malformated tubers.	Total n'mber tubers.	Total weight of tubers.
								lbs.	lbs.				lbs.
Wall's Orange	May 1	May 28	22	July 3	Sept. 21	353	414	**123**	34	**62**	9	767	**151**
Wall's Orange	May 1	May 28	22	July 3	Sept. 21	195	367	**55**	22	**29**	....	562	**77**
White Elephant	May 1	May 26	22	June 25	Sept. 21	445	690	**148**	42	**38**	66	1,135	**190**
White Star	May 1	May 28	22	July 4	Sept. 21	395	238	**179**	28	**19**	95	633	**207**
White Whipple	May 1	May 28	22	July 5	Sept. 21	538	428	**189**	34	**152**	....	966	**223**
Wild from Arizona	May 1	June 19	....	July 12	Oct. 1	....	....	....	....	....	....	....	.....
Willey's No. 10	May 1	May 28	8	July 18	Oct. 8	289	367	**96**	18	**11**	....	656	**114**

As the number of eyes that vegetated in the different rows was not uniform, we have computed the yields and numbers of the tubers in every case on the basis of one hundred hills, omitting fractions. That is to say, the Adirondac potato, of which there were twenty-two hills, would have produced one hundred and eighty-seven pounds of tubers had there been one hundred hills yielding at the rate that the twenty-two hills yielded.

The decaying tubers were treated as sound, in separating the merchantable and unmerchantable potatoes. Tubers of merchantable size that were ill-shaped, or knobby, were called "malformed."

The White Whipple variety produced the largest weight of merchantable tubers; the White Star comes second, and the American Giant third. The largest total yield was from the Grange, which produced one pound more than the White Whipple.

At the rates noted in the table, the White Whipple would have yielded a trifle over three hundred and ninety-two bushels of merchantable potatoes per acre; the White Star a little over three hundred and seventy-one, and the American Giant a little more than three hundred and sixty-nine bushels. In contrast with this the Flesh Colored, Duchesse and Long Pink Eye would have yielded but about sixteen and one-half bushels of merchantable potatoes per acre.

We commenced digging the varieties September 21. On that day, and the few succeeding days, all were sufficiently ripe to dig, except six. Breese's Red, Duchess, Scottish Champion, Steele's Red, and Willey's Number Ten were ready to dig October 8, but the McCormick continued to grow until October 16, when the foliage was destroyed by frost.

As appears in the table, the tops of the Alpha, Early Household, Flesh Colored and Vermont Champion were dead before the first of September.

A large number of varieties failed to bloom, and of those that blossomed the greater part formed no fruits. Among the varieties that formed fruits we mention the Breese's Red, McCormick, Tyrian Purple and White Whipple.

We grew, as a matter of interest, a few hills of the wild potato, the tubers of which were sent to us from Arizona by J. G. Lemon, of Oakland, California. The plants were small, growing scarcely more than six inches high. The leaves were also small, deep grayish-green, and without hairs. The stems were much branched, and deep purple at the nodes. The flowers, which were white, were numerous, but to our surprise they formed no fruits. The roots were very rambling, and some of the miniature tubers, which were about the size of filberts, were found at a distance of one and a half feet from the stem. The botanical name of this interesting plant is *Solanum tuberosum*, variety *boreale*.

The condition of the soil on which our potatoes were planted, and the character of the season, were favorable for the potato rot, and gave us the opportunity to note the relative power of the different varieties to resist this disease. As appears in the table, it seems to be largely a variety characteristic. A few varieties escaped it entirely, while others were, at the time of digging, almost destroyed by it. The Astonisher, Bliss' Triumph, Bliss Nos. 39 and 51, McCormick, Scottish Champion, a seedling from C. Baldridge, and Vermont Champion escaped the rot

entirely, while about half of the tubers of Jordan Prolific, Late Beauty of Hebron and Sunrise, and about one-third of those of Gypsy, Knapp's Snowbank, Marvel of Beauty and Pennsylvania Belle were rotten at the time of digging.

The Flesh Colored, a very old variety, which has so far deteriorated in vigor that it produced but eight pounds of merchantable tubers in one hundred (calculated) hills, had no rotten tubers, while of the Garnet Chili, another old variety, a very small percentage of the tubers were rotten. This would seem to indicate that the liability of potatoes to decay has no connection with what we term "running out." Neither does it seem to have any connection with prolificacy. The Gypsy, which was among the more prolific, had one-third of its tubers rotten, while the Alpha, one of the least prolific, had but about two per cent of rotten tubers. Again, the Beauty of Hebron, a prolific variety, had more than twelve per cent of rotten tubers, while the Astonisher, a light yielder, had no rotten tubers.

What surprises us more, the liability to decay seems to have no relation to the vigor of the plant. Thus, of the varieties that failed to rot, our notes of plants and foliage read as follows: Astonisher: "Plant feeble, leaves somewhat shriveled and blighted." Bliss' Triumph: "Plant very feeble, foliage much blighted." Bliss No. 39: "Plant very feeble, foliage much blighted." Bliss No. 51: "Plant rather feeble, foliage not blighted." Flesh Colored: "Plant very feeble, foliage shriveled, with some blight." McCormick: "Plant very vigorous, three feet high, foliage not blighted." Scottish Champion: "Plant rather feeble, foliage not blighted." A seedling from C. Baldridge: "Plant moderately vigorous, foliage slightly blighted." Vermont Champion: "Plant rather feeble, foliage very much blighted."

It appears from this that decay does not always follow, even though the foliage is severely blighted. The blight, spoken of in our notes, may not, however, have been the fungus which is the parent of the potato rot.

In two plants of the Beauty of Hebron variety, small tubers were formed in the axils of the leaves. We noted that the blight affected these in the same manner as the foliage, causing them to shrivel and blacken. The decay commenced upon the uppermost tubers and proceeded regularly down the stem until it reached the surface of the ground, when the tubers which protruded from the soil were attacked. This is in accordance with one theory of the potato rot, viz.: that the spores of the fungus fall from the blighted foliage and are washed downward through the soil by rain until they reach the tubers, when they germinate and the growing fungus destroys the structure of the potato. It seems probable, therefore, that the method that has recently been recommended in England, of hilling the plants very high as soon as the blight appears upon the leaves, may have efficiency as a preventive of rot.

It would seem that one lesson at least can be gathered from our statistics of decay. Those who are producing new varieties should scrupulously avoid using as parent varieties, those that are subject to rot. The fact that so many varieties rotted seriously on our soil the past season, is not evidence that they will rot in all seasons, but those that have shown themselves to be rot-resisting we should hardly expect would decay under any conditions that the farmer is likely to meet.

The question of synonyms in the potato is so large a subject that we have not as yet found time to consider it.

EXPERIMENT.

As was noted in the report of the director last season, the results of certain experiments in cutting the potato tuber in different ways seemed to indicate that each eye of the tuber corresponds to the terminal bud of a branch, and that all of the eyes are vitally connected to a common central axis, which extends through the tuber from the stem to the terminal eye (the center of the seed-end, so-called). The hypothesis was therefore taken that the vigor of the eye is in a degree, at least, dependent upon the depth that the section containing it extended inwards towards the center of the tuber, provided that the assumed vital connection between the eye and the central axis is not severed. The results of experiments conducted last season seemed to substantiate the hypothesis.

In order to make a thorough test of these experiments, one tuber each of eighty-nine of the ninety-two so-called varieties of potato named in the foregoing table, was cut to single eyes, after the ideal method, that is, cutting each section to the center of the tuber, but slanting the line of the cut toward the stem end at an angle of about forty-five degrees. Another tuber of each variety was cut in the same manner, except that the tuber was inverted so that the line of cut, instead of slanting toward the stem end of the tuber, slanted toward the opposite end. A moment's thought will make it evident that while the cuttings of both tubers have the same form and about the same weight, those from the first tuber preserve the entire length of the theoretical branch while those from the second sever this branch at a point shortly beneath the eye.

In treating of the two methods of cutting, we shall designate the tuber cut according to the hypothesis as the direct cut, and the one cut in the opposite direction, the reverse cut.

Eleven eyes of each tuber, that is, eleven eyes of the direct and eleven of the reverse cut of each of the eighty-nine varieties, were planted side by side, so that there were two short rows of each variety, each of which contained eleven eyes.

During the growth of the plants we frequently noted differences in the two cuttings. Thus, in the vegetation, the direct cut was first in nineteen cases, the reverse in seventeen, and in the remainder both cuts vegetated on the same day. In blooming the direct cut was first in twenty-four cases and the reverse in nineteen. In a few cases also, a slight difference was noted in the time that the tops were dead.

But the more important question is the comparative yield of the two cuttings. The direct cut yielded best in forty-eight cases, and the reverse in forty-one. The actual difference in the aggregate yields, as calculated on the basis of one hundred hills, retaining fractions, was twenty-nine and three-fourths pounds in favor of the direct cut, or, on the average, about one-third of a pound to each variety.

Eighty-nine hundred hills is almost three-fourths of an acre. A difference in yield of twenty-nine and three-fourths pounds on three-fourths of an acre is as little as could be expected in duplicate plantings, and hence we decide that the hypothesis taken last season, so far as it relates to the importance of cutting the sections in a particular direction, is untenable.

Root Washings.

We found time to do little of the interesting and important work of washing out roots, but we note what we have done.

A plant of Triomphe de Gand strawberry, the roots of which we washed out August 13, had roots extending nearly vertically downwards, to the depth of twenty-two inches. The horizontal roots were few and short, the longest being traceable but six inches. The greater part of the roots extended nearly perpendicularly downwards, and nearly all of the fibrous roots were found directly beneath the plant.

The new roots appeared growing, out about an inch above the old ones. The longest of these had attained at this time a length of six inches. They were white, and were tipped at their extremities with a thickened point, in which respect they resembled the underground stems of the potato.

It would seem from these observations that as the roots cover an area scarcely larger than the leaves, there is little danger of injuring the roots of strawberry plants by cultivation between the rows, even if the soil is disturbed to a considerable depth.

The fact that the new roots grow out above the old ones each year explains why strawberry plants appear to lift themselves upward as they become old, and suggests the importance of drawing earth toward the plants in hoeing them after the bearing season.

The roots of the tomato plant, are, in their manner of growth, opposite to those of the strawberry plant. In a plant examined August 13, the greater part of the roots appeared to extend horizontally, and were about eight inches below the surface. We traced the horizontal roots a distance of twenty-four inches on one side of the plant, and thirty inches on the other. From this it appears that the plant drew its nourishment from a circle about four and a half feet in diameter, or from an area of about sixteen square feet. A single root was traced downward to the depth of two and a half feet. The tap-root was clothed with a multitude of fibrous roots to the depth of eight inches, where it separated into many branches.

The cauliflower is a deep-rooting plant, as appears from our observations made on the same day. Roots were traced downward to the depth of three feet, and many roots reached a depth of two and a half feet. The roots also extend horizontally about two and a half feet. It thus appears that the cauliflower draws its sustenance from a greater area and depth than the tomato plant. The fibrous roots, however, are less numerous in the upper layers of the soil.

Insecticides.

We have prosecuted our experiments with insecticides with considerable vigor, and while we feel that we have made some progress, we are very strongly impressed with the difficulties of the case. Most insects fall an easy prey where Paris green can be safely used and can be so applied that the enemy will devour it. But there are cases, as with the cabbage caterpillar, where it is dangerous to use a deadly poison; and others, as with the grubs that infest the stems of squash and cucumber vines, where it is extremely difficult to apply any poisonous substance so that any portion of it will be devoured by the insect. Here difficulties arise at once.

If much of our testimony on the subject of insecticides seems to the reader non-committal, we can only remind him that one season is not long enough to make conclusive experiments, unless we are fully decided beforehand upon our point of attack, and this, to the experimenter, is often impossible.

One of the first insects with which we have to contend in spring is the cabbage flea beetle, *Haltica striolata*. This is the spry, little, dark-brown beetle that is so destructive to the young plants of cabbage, radish and turnip. Strange to say, Paris green mixed with plaster in a quantity that is doubly sufficient to kill the potato bug has no effect upon this insect. It seems probable, therefore, that it does not eat the epidermis of the leaves. We found, however, that strong tobacco water either destroys it or drives it away from the plants. The decoction of tobacco must be as strong as it can be made by soaking the leaves in cold water, or it will not avail. We mention here that hot (not boiling) water extracts more of the strength of the leaf than cold water.

With the striped cucumber beetle, *Diabrotica vittata, Fabr.*, tobacco water was of no avail. We found, however, that Paris green mixed with ground limestone at the rate of one part to one hundred, by weight, was in a degree efficacious. We tried placing corn cobs dipped in coal tar about the plants, and also cobs dipped in kerosene oil, and in turpentine. These noxious substances had some effect in driving off the beetles, but were not entirely effectual.

We have this insect to battle in two forms. Its larva, in the shape of a small white grub, attacks the root of the plant, girdles it, and sometimes perforates it with holes. This is what so often causes the young plants of cucumber and melon to shrivel and die soon after the first leaves are developed. We found that Paris green mixed with water at the rate of an ounce to three or four gallons, poured about the stems of the young plants seemed to prevent the grubs getting a foothold, when the plants were not already infested. It did not, however, destroy the grubs inside of the stem. It will not answer to wait until the shrivelled foliage tells that the stems are already infested. In applying the mixture to the stems, were moved carefully, with a trowel, about an inch of the surface-soil about the plants, poured the poisoned water about the stem from the spout of a sprinkling pot, and replaced the soil. It is best to do this in the evening, or on a wet day. As this insect is the larva of the striped bug, we may expect to meet it wherever the latter abounds. It should not, however, be confounded with the squash-vine borer, *Melittia cucurbita, L.*, which is a different insect, and of which we shall treat later.

We found that one pound of Paris green, thoroughly mixed with two hundred of ground limestone, is quite efficient in destroying the larvæ of the potato beetle, *Doryphora decemlineata, Say.* We had formerly used one part to one hundred. Our experiments show that we may reduce the cost and the danger of applying Paris green for the potato bug one-half. We would emphasize the importance of thorough mixture, however, where so small a proportion of poison is used. Ground limestone has about the same specific gravity as common land plaster, and the latter would doubtless answer as well.

Next in order of the season comes the cabbage caterpillar, the larva

of *Pieris rapæ, L.* We made thorough experiments with the emulsion of kerosene oil, which we found successful last season, with the view of discovering the least amount of oil and soap that would prove efficient. We found that one ounce of common, yellow, hard soap, one pint of kerosene oil, and one and one-half gallons of water, thoroughly mixed, will destroy all of the worms that are wet with the mixture. We applied it with a watering-pot having a fine rose.

Care must, however, be taken to keep the ingredients thoroughly mixed, for if the oil is permitted to rise to the surface so that it all passes out upon a few plants, it will prove fatal to the few, while the remainder will not receive enough to destroy the worms. The kerosene is the insecticide, the object of the soap being only to thicken the liquid so as to retard in a measure the separation of the oil from the water. A larger proportion of soap makes the water so thick that it will not flow readily through the openings of the rose. A larger proportion of oil endangers the plant, while a smaller proportion is inefficient against the worms. Having decided upon this formula, which cost a multitude of experiments, and not a few cabbages, we proceeded to apply it to the plants regularly at intervals of once a week, but it soon became evident that only a few varieties were able to endure such frequent treatment. The leaves of the early varieties shrivelled and blighted, and in some cases the plants drooped and died. It was a matter of interest to note what a difference exists in the powers of endurance of different varieties. Some varieties failed to show the effect of five successive applications, while others shrivelled after a second application.

It is evident from the above statements that our remedy is not a satisfactory one. The perfect remedy should not only destroy the worms whenever it touches them, but it should not injure the plant in the least under any number of applications. We hope next season to repeat our experiments, using an atomizer in place of a watering-pot.

We made many experiments with other applications, but none offered so much promise of success as the formula named.

Bi-sulphide of carbon has frequently been recommended for preventing the attacks of the squash-vine borer, *Melittia cucurbitae.* We filled small bottles with cotton, saturated the latter with this liquid, and placed these in the soil about squash vines early in July. A pin inserted at the side of the cork permitted a constant but very gradual exit of the fumes of the liquid which were temporarily absorbed by the soil. The cotton in the bottles was repeatedly saturated with the liquid as it became dry. The plants soon withered under the influence of the noxious fumes, though the bottles were often placed a foot from the stems; but we noticed no diminution of the borers. Indeed, we often found them in close proximity to the offensive bottles. It became evident that we must battle with our enemy above ground if our efforts were to avail anything.

Accordingly, we very carefully removed the borers from a few vines and applied a mixture of Paris green and water to the stems, using enough of the poison to faintly color the liquid. This proved unquestionably beneficial. We commenced its application about August 20th, and afterwards found very few borers in the plants treated with it, though they were of varieties very subject to their attacks. A care-

ful examination, made September 5th, discovered but two borers in eight plants, while other plants in the same row, to which no application had been made, contained from one to three borers each. The Paris green and water was applied in this case with a watering pot having a fine rose with the apertures facing downwards. The stems were wet for a distance of about two feet from the base of the plants. We must caution here against using too much Paris green, as in one of our experiments the stems shrivelled and died after the application.

The mixture doubtless acts in this case by poisoning the minute grub, as it eats its way from the egg whence it is hatched to the center of the stem.

We made another experiment for the squash-vine borer that seems to promise valuable results. This was the application of a solution of sulphate of iron (copperas) about the roots. We used this solution upon five vines about August 22. All of these vines had been infested by borers, and at the time the experiment was made, four of them were almost destroyed by them. The borers were very carefully removed by splitting the stem lengthwise to the center and picking out the worm with a pair of tweezers. The solution was then poured about the base of the plants, sprinkling it upon a circle about four feet in diameter, taking care not to allow any to touch the leaves. In these vines we found no borers after the application was made. The vines soon assumed a deep green color and grew vigorously until destroyed by frost. The proportion used was one-fourth of a pound of copperas to a gallon of water, and a gallon of the solution was used upon each plant. We do not know in what way, if at all, the copperas acts in this case to prevent the work of the grub.

We do not regard these experiments with the squash-vine borer as in any sense conclusive. We hope to make very careful verifications of them next season. In the meantime we would invite all growers of squashes to aid us in practical trials.

THE CROSS-FERTILIZATION OF VARIETIES.

During the summer and autumn of 1882, we gathered seeds, as far as possible, of all the annual vegetables then growing in the Station garden. During the past season we have repeatedly noted that the plants grown from these seeds show indications that the flowers which produced them were cross-fertilized with other varieties. The evidence of this was perhaps more conspicuous in the pepper than in any other vegetable that came under our observation. Last season our plants of New Cranberry, Small Red Chili, Oxheart and Cherry Red Pepper all produced fruits that were true to the descriptions of these varieties. Seeds taken from these fruits, however, produced plants that bore but a very small proportion of their fruits true to type. In the New Cranberry, for example, the fruits were all at least double, and in many cases many times the size of those of the true variety. Fruits of the Oxheart and Red Cherry peppers also were very oblong in form. We noticed a difference in the manner of growth of the young plants before they had been removed from the hot-bed, and transplanted a few of the more conspicuous variations to rows by themselves. Later in the season the cause of the variation became

apparent. These plants showed by their fruits that they were from cross-fertilized seeds.

In the fruit of some of our tomato plants also we noticed variations so marked that we could only account for them by the theory of cross-fertilization. It has been claimed that the flowers of the tomato are cross-fertilized only by art. Upon inquiry, however, we find that some of our best seed-growers believe that the varieties will inevitably mix if grown in close proximity. This may account in part for the unfixity that exists in so many varieties of tomato.

In the report of the Assistant it will be seen that many of the varieties of bean grown the past season show unmistakable evidences of cross-fertilization.

In order to note how common is the tendency to cross-fertilization in different species of plants, we, last season, gathered seeds of many of our cultivated flowers, by color; that is, putting in one package only the seeds from flowers of a particular shade or combination of shades. The samples gathered were numerous, embracing the different shades of balsam, petunia, zinnia, phlox, dianthus and aster. These seeds were planted last spring, and but two of the samples produced plants of which all that were permitted to blossom bore flowers of a uniform shade, and in one of these the shade was entirely different from that of the parent flower. The case which seemed to come true was a single sample of aster.

It would appear from this that, at least in our common flower-garden plants, cross-fertilization is the rule.

During the past summer we have noted that the flowers of nearly all of our vegetables are frequented by insects, the humble-bee in particular. We are informed by those who grow peas for seed that even in this plant, in which, as we have already noted, the petals seem to inclose entirely the organs of fructification, cross-fertilization sometimes occurs. It seems entirely safe to say that as a rule, to which there are a few exceptions, different varieties of vegetables are sure to become mixed if grown for seed adjacent to each other. In consideration of this fact, we are inclined to wonder that purchased seeds so often produce plants true to type.

Synonyms.

We present the names of the various vegetables grown which we believe to be synonyms, in condensed form, as follows:

We have marked those in which we desire to repeat our observations with the interrogation point.

Beet.— Dark Red Egyptian; Eclipse; Mammoth Long Red Mangel; Norbition Giant; Long Red Mangel; Henderson's Colossal Long Red.

Cabbage.— Schweinfurt; Large White Schweinfurt; Schweinfurt Quintal; Quintal Drumhead; Strasburg Quintal.

Carrot.— Early French Scarlet Forcing; Gartier's Red Horn (?); Extra Early Forcing (grown in 1882); Early Horn (?).

Egg Plant.— Tomato-shaped Red; Tomato-formed Red; Scarlet Chinese; Long White China; White Long Chinese.

Lettuce.— All the Year Round, Black Seeded Satisfaction, Salamander; Prize Head, Ferry's Early Prize Head; American Gathering; Frankfort Head, Gray Seeded Butter; Hardy Green Winter, Hammersmith Hardy Green; Large Princess Head, French Imperial Head,

Curled Simpson, Perpetual; White Seeded Tennis Ball, White Forcing Head, White Cabbage, Large White Stone Summer.

Muskmelon.— Christiana, Improved Orange Christiana.

Parsnip.— Long Hollow Crown, Abbott's Hollow Crown, Sutton's Student, Guernsey or Cup, Carter's New Maltese; Turnip-rooted, Round, Early Round or Turnip.

Pea.— Cleveland's First and Best, Ferry's First and Best, Sibley's First and Best, Thorburn's First and Best, Henderson's First of All, Hancock, Philadelphia Extra Early, Day's Early Sunrise, Eugenia (?), Blue Imperial, Dwarf Blue Imperial; Carter's Premium Gem, Premium Gem.

Pepper.— Large Bell, Bull Nose, Sweet Mountain, Oxheart, New Oxheart, Tomato Shaped, Squash, Large Squash.

Radish.— Scarlet Turnip Rooted, Early Scarlet or Red Turnip, Early Scarlet Turnip Rooted.

Squash.— Turban, Low's Premium Hybrid (?), Essex Hybrid (?).

Tomato.— President Garfield, Great Chihuahua (?), Acme, Essex Early Hybrid (?), Early Red Smooth, Early Round Red Smooth (?), Extra Early Red (?), Large Red (?), Large Red Smooth Round (?).

FRUITS.

Our experimental work in the fruit department the past season has been small. The apple crop was substantially a failure. The pear, peach, plum and cherry trees yielded a fair crop of fruit, but we found no opportunity for experimental work upon these. The disease known as "curl-leaf" attacked the foliage of our peach trees last spring, as it did in the spring of 1882. We made inquiry as to the nature of this disease of Prof. J. Henry Comstock, the entomologist of Cornell University, which elicited the following letters of information:

"The peach trees are suffering from the disease known as "curl-leaf," a common disease, which is sometimes very destructive. This is especially the case in California. I have not seen so much of it in the East as I have in that State. So far as I know, nothing is known of the cause or nature of the disease.

"When plant lice (aphidae) attack peach leaves, they cause a similar appearance, but "curl-leaf" strictly speaking, is independent of the presence of any insect."

This letter published in the Station Bulletin No. 48 brought out the following letter from Dr. B. D. Halsted of New York city, who is especially skilled in that branch of science which includes the injurious fungi:

"May I add to the information on the peach curl given in the Bulletin for June 16th? This injurious deformity of the peach leaves has been ascribed to plant lice and other insects, but it is now known to be caused by a minute fungus known to science as *Taphrina deformans*. This minute parasitic plant makes its appearance in early spring and causes the foliage to twist and curl out of its natural shape. The fungus is not distantly related to the one which causes the black knot of plum and cherry trees, and, so far as I know, the same remedy is the only one used, viz., to remove and burn all of the affected parts as soon as they appear. It is best to cut off the young twigs bearing the "curled" leaves, and this can be done quite rapidly. Care should be taken to burn all the parts removed to prevent the ripening of spores in the infested leaves.

Our pear trees were not affected with blight the past season to any extent. The black knot appeared in great abundance on a few of our plum trees during the latter part of summer, but the affected parts were promptly removed.

Raspberry.

The raspberry plants set out in the spring of 1882 bore a partial crop of fruit the past season. As the plants were not fully grown we did not take careful notes of the comparative productiveness of the different varieties. We have, however, the following notes on the time of maturity, size, color and flavor of the fruits:

Davison's Thornless — A few berries ripe July 4; fruit medium to small; black.

Belle de Palluau — Several berries ripe July 6; bright crimson; medium to small, rather soft, sweet and rich.

Clarke — A few berries ripe July 6; rather large; light crimson, slightly oblong, moderately firm, flavor good.

Highland Hardy — Several berries ripe July 6; red; medium, roundish, rather soft, flavor excellent.

Knevet's Giant — A few berries ripe July 10; light crimson; very large, some specimens measuring three-fourths of an inch in diameter globular, moderately firm, but quite deficient in flavor.

Mrs. Wood — A few berries ripe July 10; red; medium, roundish, or slightly oblong, rather soft, of good flavor.

Philadelphia — A few berries ripe July 10; rather small; dark red; roundish, moderately firm, of good flavor.

Red Antwerp — A few berries ripe July 10; rather small; dark, red with large globules; rather soft, of good flavor.

Turner — A few berries ripe July 10; red; medium; slightly oblong, rather soft, of delicious flavor.

Belle de Fontenais — A few berries ripe July 12; deep crimson; large, slightly oblong, rather firm, flavor good; this variety produced a small crop in autumn, also.

Brandywine — A few berries ripe July 12; scarlet; rather small, roundish, firm, of poor flavor.

Cuthbert — A few berries ripe July 12; a red raspberry of medium size, slightly oblong, very firm, of excellent flavor; this variety ripened its crop gradually.

Fastolff — A few berries ripe July 12; crimson; medium; roundish, moderately firm, of good flavor.

Henrietta — A few berries ripe July 12; red; rather large, obtuse, conical, moderately firm, of good flavor.

Herstine — A few berries ripe July 12; bright crimson; medium, roundish or slightly oblong, moderately firm, flavor rather inferior.

Reliance — A few berries ripe July 12; dark red; rather large, roundish, flavor good.

Thwack — A few samples ripe July 12; red; medium, roundish, rather soft, flavor inferior.

Early Prolific — A few berries ripe July 14; medium to large; red; rather firm, deficient in flavor; plant very productive and almost without spines.

Parnell — A few berries ripe July 14; bright red, rather above medium, obtuse conical, rather firm, flavor good, but not best.

Vice-President French — A few berries ripe July 14; red; of medium size, firm, flavor rather inferior.

Delaware — A few berries ripe July 16; bright red; medium to small, roundish, rather soft, but of a very pleasant flavor.

Prosser — A few berries ripe July 16; dark red; medium to small, very firm, flavor inferior.

Yellow Antwerp — A few berries ripe July 16; medium to small; pale yellow; roundish, juicy and sweet, soft, but of a very pleasant flavor.

Mammoth Cluster — A few berries ripe July 16; black; large, roundish, firm, of good flavor.

Seneca — A few berries ripe. July 16; black; rather small, firm, juicy, of good flavor.

Gregg — A few berries ripe July 20; black; rather large, but lacking in flavor; plant productive.

Plants of Brinkle's Orange set out in the spring of 1882 perished in the following winter.

CURRANTS.

We also tested the following varieties of currant:

The Cherry, Red and White Dutch, Victoria, Short Bunched Red and White Grape varieties ripened about June 25. The fruits of the Cherry were nearly or quite twice as large as those of the Red Dutch, those of the Victoria were slightly larger, growing on much larger bunches, those of the Short Bunched Red were slightly larger, and of the White Grape considerably larger than those of the Red Dutch.

Of Black Currants, the Black English ripened its first fruit July 17, a little earlier than Black Naples, Baldwin's Black and Ogden's Black Grape. Its berries are slightly smaller than those of the latter three varieties, between which we noticed no marked differences.

The Missouri Sweet Fruited is much later in ripening. The berries are small, black, and produced in great abundance, but the flavor is too insipid to make them desirable.

Unfortunately the Black Currants, though possessing the valuable qualities of extreme hardiness, great productiveness and entire freedom from the attacks of the currant worm (*Nematus ventricosus Klug*), are so unpleasant in flavor as to make them undesirable additions to the fruit garden.

STRAWBERRY.

Of the Strawberry, we tested but three varieties, the Hervey Davis, Wilson's Albany and Triomphe de Gand. The berries of the first were very fine in appearance, and of delicious flavor, but with us, it was not sufficiently productive to be valuable.

The other two varieties are already well known. We will only add that the Wilson's Albany yielded about twice as much fruit from the same area as the other two combined.

AMELANCHIER CANADENSIS, VAR. OBLONGIFOLIA.

A few of the plants of this shrub set out in the spring of 1882,

bore a small crop of fruits, which were about the size of huckleberries, of a deep purplish color, and of a peculiar but quite agreeable flavor. If the plant should prove productive in cultivation, the unique flavor of the fruits would doubtless gain for it many friends.

HUCKLEBERRY.

We made the experiments of growing the Huckleberry from seed. We preserved the seeds of fruits gathered during the summer of 1882 in moist sand and planted them November 24, in boxes, in the greenhouse containing soil formed of equal parts muck and sand. The first plants appeared January 7, the seeds continuing to vegetate for several weeks thereafter. The young plants seemed quite hardy, as they endured some vicissitudes of heat and dryness. They made, however, very little growth, and during the past summer failed to become sufficiently large, to transplant. The slow growth may have been due to the fact that the muck used in the boxes was fresh, having but just been taken from the swamp. The species were unknown as the seeds were obtained from several different sources.

As an evidence that some have success in growing the huckleberry, we publish the following letter recently received from Mr. W. J. Scott, of Bridgewater, Oneida county, N. Y.:

"About fifteen years ago I planted a quantity of huckleberry bushes on my farm, taking them from a cold, wet swamp. My soil is dry and gravelly, good corn land. The plants were of both the high bush and the low kind. They have borne abundantly, and we now have huckleberries by the bushel a good part of the season. The bushes grow taller and better than those in the swamp, and the berries are a great deal larger on both the high and low bushes.

"If you want to grow huckleberries, set out young plants, about a foot high, in the spring. Mulch them for a year or two and plow in some coarse horse manure occasionally. They are slow to start, but after they are started they grow rapidly, both in bush and berry. The bushes may be cultivated with a horse. They should be set at least seven feet apart each way, as they spread considerably when full grown. It is well to set three or four small bushes in each hill."

Plants of the huckleberry set out on the station farm last spring made a vigorous growth during the summer and autumn.

TOBACCO.

Our chief experiment in tobacco culture the past season consisted in the application of seven different chemicals and fertilizers with the view of noting the effect upon the yield of the crop and upon the burning quality of the leaf. The information gathered last season in washing out the roots of tobacco plants made it evident that in order to secure reliable results from the application of different fertilizers, the latter should be deposited upon an area reaching at least three feet on each side of the row from which the sample leaves are to be taken, and that no attempt should be made to apply different fertilizers to adjoining rows. As the composition of the leaf in tobacco depends somewhat upon the length of time that the plants are allowed to stand after topping, it is evident that in experiments with different fertilizers, the sample leaves should only be taken from plants that were

topped at the same stage of growth and upon the same day. In our experiments the past season we have observed those rules with care.

The soil on which our tobacco was grown is a heavy clay. It was liberally fertilized in the spring of 1882 with well rotted horse-manure mixed with scarpings from the hen yard. Of its previous treatment we know nothing, though at this time it appeared to be in a high state of cultivation. No fertilizer was applied in the spring of 1883, except those which contributed to our experiments.

The variety of tobacco grown was that known in southern New York as the "Brand," being a very vigorous strain of the Connecticut Seedleaf. The plants were started in the cold frame and transplanted June 8th, in rows sixty feet long and three and one-half feet apart, the plants being set two feet apart in the row.

July 16th we applied fertilizers as named below, distributing the substances as evenly as possible over the surface of the soil for three and a half feet on either side of the rows mentioned. As appears, two rows were passed over between each two fertilizers.

Row No. 1, one pound muriate of potash applied in solution.

Row No. 4, one pound nitrate of potash (saltpeter) applied in solution.

Row No. 7, one pound sulphate of iron (copperas) applied in solution.

Row No. 10, two pounds sulphate of potash applied dry.

Row No. 13, one pound sulphate of potash applied in solution, and two pounds National Superphosphate applied dry.

Row No. 16, five pounds sulphate of lime (land plaster) applied dry.

Row No. 19, five pounds slacked lime applied dry.

The plants were topped very soon after the embryo flower was visible, and were cut and hung August 26th. The plants from the fertilized rows were hung in the center of a block, where they were surrounded on all sides by other plants, to guard against inequality in curing. They were taken down November 22, and the leaves stripped off and weighed November 24.

In the table below the weights given in pounds and decimals of a pound are of ten plants that were topped on August 11, from each of the fertilized rows.

		Ten plants weighed green, lbs.	Ten plants yielded of cured leaf, lbs.	Per cent by weight of cured leaf.
Row 1.	Muriate of potash...	29·042	3·187	10·974
Row 4.	Nitrate of potash...	28·576	2·422	8·486
Row 7.	Sulphate of iron....	31·599	3·269	10·345
Row 10.	Sulphate of potash...	29·983	2·969	9·902
Row 13.	Sulphate of potash with superphospate	38·702	3·894	10·062
Row 16.	Sulphate of lime....	27·643	2·695	9·026
Row 19.	Slacked lime	34·453	2·945	8·548

During growth no difference was noticed in the various rows, but, as the figures indicate, a difference really existed. The fertilizers seem to have had an influence not only upon the weight of the green plants, but also upon the percentage of cured leaf. This is a reminder that

the farmer in making experiments upon tobacco with different fertilizers should not depend upon appearance alone, as a fertilizer may exert a considerable influence upon the crop without the fact being discernible to the eye.

We submitted samples of cured leaves from each of the fertilized rows to a tobacco expert, who pronounced the burning quality of all the samples as all that could be desired, except the one from the row to which the sulphate of iron was applied, and that this sample was so little inferior to the others as to be scarcely worthy of remark. It is possible that the soil upon which our tobacco grew was so thoroughly impregnated with plant food that the influence of the chemicals applied was unnoticeable. It seems certain, however, that they had a perceptible effect upon the growth of the plants.

The Superior Yield of Early Plants.

In our report for 1882, we noted that the plants of tobacco which made the most rapid growth attained the largest size, and also retained when cured the largest precentage of their green weight. Wishing to make further observations on this point we have noted the weights, green and cured, of plants topped at different times, but harvested on the same day. The plants were topped when the flower stalk first appeared, hence the time of topping represents very nearly their comparative earliness.

In the following table we give the weights, green and cured, of ten average plants of each date of topping, appending in each case the percentage (by weight) of cured leaf. The plants were all harvested August 26th:

Ten plants topped.	Days before havesting.	Weight green, lbs.	Weight of cured leaf lbs.	Per cent of weight of cured leaf.
July 31	26	41.0	4.062	9.909
August 2	24	32.6	3.373	10.347
August 4	22	32.9	3.628	11.027
August 11	15	29.4	2.578	8.768
August 17	9	23.2	2.315	9.978
August 18	8	21.8	2.007	9.206
August 22	4	16.7	1.378	8.252

It thus appears that with a single exception the weight of the green plants and of the cured leaf shows a constant gradation downward from the earliest to the latest topping. In the percentage of cured leaf, however, we do not find the same gradation; hence we conclude that this does not wholly depend upon the time that the plant is allowed to stand after topping, although our experiments of last year seemed to warrant such a deduction.

It appears, however, that the earliest plants yielded about three times as much weight of cured leaf as the latest ones, and this difference is practically augmented by the superior quality of the product of the early plants.

We noted last season, as we have very often noted in previous years, that the largest plants in the seed-bed formed the earliest plants in the field. This then, is a strong argument in favor of an extensive

plant bed, which makes it possible to practice selection at the outset by setting only the plants that make a vigorous start.

EFFECT OF SPLITTING THE STALK UPON THE WEIGHT OF CURED LEAF.

Last year we compared the weights, green and cured, of plants hung with twine, and with the spear. Our results indicated a slight loss in weight in those hung with the spear. We have continued our experiments upon this point with the following result:

One hundred pounds green tobacco, hung with:	Yield. Cured leaf, lbs.	Yield. Stems, lbs.
Hook, stems not split at all, yielded.............	10.84	16.14
Spear, stems slightly split..............	11.03	13.07
Stems split nearly the whole lenghth.............	9.24	6.81

The average yield of cured leaf from one hundred pounds of green tobacco topped at various times, was 9.63 pounds. It appears therefore that in this case both the plants hung with the hook and the spear yielded more than the average weight of cured leaf and that the yield from those hung with the spear was the larger. The weights of the stems, however, show clearly that the splitting hastens their drying, and in the plants of which the stems were split nearly the whole length, the weight of the cured leaf seems to have been materially diminished.

We handed sample leaves taken from each of the three methods of curing to a tobacco expert, who knew nothing of their treatment. The leaves from the stalks hung with the spear were pronounced perceptibly thinner than those from stalks hung with the hook, but not inferior to them in quality. Those from the stalks that were much split were pronounced very inferior in quality.

If we average our results of 1882 and 1883, we find that the plants hung without splitting the stalk yielded 10.59 pounds of cured leaf to 100 pounds of green plants, and those hung with the spear yielded 10.15 pounds to the same weight of green plants.

These experiments seem to indicate that splitting the stalk has a tendency to hasten its drying, and probably to hasten the drying of the leaf also, and that the tendency is to produce a thinner leaf, but in the amount of splitting that is usually practiced in using the spear the weight of cured leaf is not materially influenced.

Some tobacco growers are of the opinion that plants harvested immediately after a heavy rain yield a lighter proportional weight of cured leaf than those harvested during a period of fair weather.

Our observations on this point indicate that this opinion is entirely correct. A rainfall of almost two inches occurred on August 28, 29 and 30. We harvested a few plants as soon as the leaves were dry on the 30th, others on the 31st, and again on September 3. The influence of the protracted rain is not perceptible in our weighings, because the loss of weight occurred before the green plants were weighed. It is, however, easily perceptible in the quality and texture of the leaf. In the plants harvested August 30, the leaf is very thin and lacks oili-

ness. We regret that we are unable to express the influence of the rain in figures, but we regard the subject as worthy the attention of the tobacco grower.

The past season, in our crop, "fat" leaves occurred chiefly on plants that were topped late. We noted that the plants topped August 22 averaged about two and one-half "fat" leaves to the plant; those topped August 18, averaged one and one-fifth to the plant; those topped August 17, averaged one to the plant; those topped August 11 averaged about one-fourth of one to the plant, and those topped earlier furnished only one "fat" leaf to sixty-five plants.

Observations Concerning Pole Burn.

With the view of studying the subject of pole burn, we hung August 30 a few plants of tobacco in the green-house, where the conditions of heat and moisture were in a degree under control. We gave air to the house only as the growing plants required it, and in dry weather secured a humid atmosphere by sprinkling abundance of water upon the floor.

On September 3, the inner leaves of the plants were noted as feeling very clammy, but contrary to our expectations, pole burn did not appear until September 14, fifteen days after the plants were hung, although the average temperature of the house at noon for this time was about eighty degrees.

On September 10, we hung a few plants of tobacco in three barrels in the green-house, with the view of making experiments calculated to arrest the progress of pole burn. One barrel was thoroughly fumigated with sulphur fumes before inserting the plants; the others were not treated. After putting in the plants, the barrels were covered with canvas to prevent a change of atmosphere within them. On the evening of September 13 no pole burn was seen, but on the following morning it was visible upon the plants in all the barrels. The partially cured leaves assumed an oily, translucent appearance, like that of oiled paper, and the pole burn appeared, in small whitish spots. In these spots the structure of the leaf was already destroyed, the latter having little more strength than wet paper. The midribs of the leaves were also affected in places with an appearance of mould, beneath which their structure seemed to be destroyed. The air in the green-house the previous evening showed a temperature of sixty-nine degrees, and was saturated with moisture, as was indicated by the hygrometer. This was the first time that the atmosphere in the house was noted as being saturated since August 30. Whether the commencement of the pole burn was due to this fact or not, we do not know.

We found that pole burn may be propagated from one plant to another by innoculation. We also found that burning sulphur in the barrels stopped the progress of the affection, but that it commenced again shortly afterward. We placed in one barrel a little of chloride of lime, and in a second a little quick-lime, but neither of these was effectual in arresting the progress of the affection.

We submitted specimens of leaves affected with pole burn to Prof. Wm. Trelease, a learned fungi specialist of the University of Wisconsin, and received the following reply:

"I am sorry to have to reply that I find nothing tangible in the tobacco leaves which arrived in good condition. Last year I spent some time over "pole burn," but found nothing but bacteria in the leaves. The trouble has many characters of a bacterial fermentation, but I know too little about it to even have an opinion on the subject.

WM. TRELEASE."

We may safely assume, therefore, that very little is known as to the cause or the nature of pole burn. Our observations indicate, however, that there is little danger of injury to tobacco from this cause so long as the leaves remain green, as we failed to find a leaf affected with pole burn that was not first considerably advanced toward curing.

We close our remarks upon tobacco by presenting an abridged translation of an excellent article on tobacco by M. Th. Schloesing, contributed to the *Dictionnaire de Chimie* of Ad. Wurtz, Paris, 1878:

[Translation.]

The products of tobacco culture are eminently variable, being dependent upon the climate, the conditions of soil, the fertilizer used, the variety grown and the habits of the planter. The relation between the conditions and the products offer matter for interesting study in agricultural chemistry.

VARIETIES.

The physical characters of tobacco, *i. e.*, the form, size and texture of the leaves acquired in one locality, after long culture, transmit themselves with persistence through generations under another climate. Thus, the Havana tobacco, where sheltered from hybridization, has not undergone visible alteration during five years of field cultivation in Boulogne-on Seine, and what is more remarkable, all foreign varieties imported into Boulogne have preserved the same percentage of nicotine that they possessed in their original countries.

The aroma, however, is not transmissible as is the percentage of nicotine. The Virginia, Kentucky and Havana varieties cultivated at Boulogne do not at all retain the flavor so characteristic of the parent plants.

THE STRENGTH OF TOBACCO.

This is in direct relation to the proportion of nicotine, and this, we know not why, is in relation to the thickness of the leaf. Tobaccos having thin leaf contain from one to three per cent of nicotine, and as high as ten per cent has been noted in those having thick leaf. The planter can regulate in a measure the thickness of the leaf by cultivation. Thus, in increasing the thickness of planting and in leaving on each plant a larger number of leaves, he obliges his field to nourish a larger number of leaves at the expense of their thickness. It is necessary, however to practice this method in moderation. If more than 22,000 to 24,000 plants are grown to the acre, or if more than ten or twelve leaves are permitted to remain on the stalk, the tobacco becomes too light to endure manipulation.

Manures have little influence on the strength of tobacco. Their action shows chiefly on the weight of the crop. The leaves are small or large but their percentage of nicotine continues about constant.

There is a sure means to obtain light tobacco without crowding the plants and without recourse to a special variety. The nicotine does not develop during the growth of the plant parallel with the other characters; that is, the proportion does not vary from none in the young plants increasing regularly until the harvest. W. Schloesing has several times verified this fact by determining the nicotine at various times during the period of growth. Here is an example of his successive determinations:

	Per cent of nicotine in dry leaves.	Increase.
May 25, leaves very young...........	·79	
July 18, 53 days later................	1·21	53 per cent
Aug. 6, 19 days later................	1·93	59 per cent
Aug. 27, 21 days later................	2·27	13 per cent
Sept. 8, 12 days later............ ...	3·36	48 per cent
Sept. 25, 17 days later................	4·32	80 per cent

It thus appears that during the last period of seventeen days the increase of nicotine was greater than during any previous period of the same length (E. S. G.).

Mr. Schloesing deduces from this that by advancing the harvesting we can reduce the percentage of nicotine.

Judging from the trials at Boulogne the quality of the leaves does not suffer by early harvesting. Indeed, in Cuba the leaves for wrappers are harvested as soon as they attain their full size, whereas in France it is customary to leave them five or six weeks after this time. The leaves of the Cuban tobacco contain two to two and a half per cent of alkaloid, and those of the French from six to eight per cent when allowed to reach the season of maturity, so called. In harvesting, immediately after the leaves attain their size, we lose from one-eighth to one-tenth of the weight.

Burning Quality.

The most important character of a tobacco is its burning quality. The pipe or the cigar should remain ignited during the time between two natural inspirations of the smoker. Such is the definition of burning quality; it is in proportion to the length of time the tobacco will remain ignited without the help of the smoker. A tobacco, which rolled into a cigar, keeps fire for three minutes, has very good burning quality; if it keeps it two minutes, it has fair burning quality; if one minute, or one-half of a minute, it has poor or very poor burning quality, and if less than half a minute, it is said to be without burning quality.

Burning quality is absolutely independent of the variety of tobacco, the thickness, strength or flavor of the leaf, or the climate under which it is grown. It depends upon the proportion of the organic salts of potash contained in the leaf, and consequently upon the richness in potash of the soil on which the tobacco grows. This fact explains why tobacco of good and poor burning quality are found among the products of all tobacco-producing countries. It is by experiments in the laboratory, and by direct test in culture that the theory of burning quality has been established.

When the ashes of a tobacco of good burning quality are washed in cold water, some carbonate of potash is always found in the solution. We do not find this when the tobacco is not combustible. The soluble potash is then entirely in the condition of the sulphate or the the chloride. There is then a relation between the combustibility and the presence of carbonate of potash (the tobacco containing no soda). Or the carbonate is a product, in fact, of the combustion. The relation shown then is due to the compounds from which the carbonate is derived; that is to say, to the nitrates and to the organic salts of potash. The nitrate may be laid entirely aside. In fact, tobaccos that contain much of it are incombustible, while others that contain none of it burn perfectly. The efficiency of the organic salts, however, can be directly demonstrated.

When in an incombustible tobacco we incorporate a certain proportion of malate, citrate, oxalate or tartrate of potash sufficient so that the ashes will contain some alkaline carbonate, the tobacco becomes combustible. On the other hand, when we incorporate in a combustible tobacco a certain proportion of sulphate or chloride of calcium or manganese, so that the ashes contain no more carbonate of potash, the tobacco becomes incombustible. In this case the larger part of the organic salts of potash has been converted by double exchange into organic salts of lime and manganese.

It is certain then that the sign of combustibility (burning quality) is the presence of carbonate of potash in the ashes; that its absence is the sign of incombustibility. That suffices to guide the cultivator. He knows now that the soil should furnish a quantity of potash sufficient to produce combustibility, and that it must be applied if wanting; but under what form and combination? These new questions have been resolved by direct trials in culture in fields almost desolate of potash. It has been found

1. That the chloride of potassium (muriate of potash) should be rejected; the chlorine passes with the potash into the tobacco and the alkali thus neutralized does not concur to the formation of organic acid salts.

2. That the sulphate agrees perfectly; that the potash is assimilated to the exclusion of the acid.

The nitrate and the carbonate also are entirely suitable, but their price is too high. That of the sulphate is, on the contrary, now quite reasonable.

In regard to the quantities to employ, these are evidently variable according to the previous treatment of the soil, and its absorbing power for alkali, etc. Direct trials alone should guide the cultivator in such matters. The potash is not lost in the soil so that when a soil has acquired a sufficient quantity of alkali to produce combustible tobacco, the condition may be kept up by supplying a calculated amount equal to that taken off in the harvest. Too much potash causes the leaf to burn with a black ash.

REPORT

OF THE

ASSISTANT DIRECTOR ON BEANS.

INTRODUCTORY.

In addition to the seventy-nine named beans grown at the Station in 1882, all of which have been again grown in 1883, one hundred and seventy-two other varieties or names of varieties were obtained and planted. Some, however, failed to vegetate. The additions consist of twenty-one varieties other than those grown last year obtained from various American sources. Forty-two varieties under French names from Vilmorin-Andrieux et Cie., Paris, France; twenty-four German varieties under English names from Ernst Benary, Erfurt, Germany; twenty-nine German varieties under German names through the kindness of Mr. W. H. Kent, Gottingen, Germany; five unnamed varieties from Venezuela, through the kindness of Hon. Horatio N. Beach, U. S. Consul, Puerto Cabello; nineteen varieties of the southern Cow Pea from various sources; eight varieties of the Japanese Soja bean (Soja hispida, *Moench*) from various sources, three of them through the kindness of H. Saze, Tokio, Japan; seven miscellaneous novelties, mostly from Japan, from H. Sibley & Co., Rochester, N. Y., and eighteen selected variations from the Station crop of 1882. Of course many of these, especially the foreign ones, were found to be identical with those already grown, but this will be treated in detail further on.

Owing to the cold weather throughout the season, and the early frosts, the Lima beans and the Southern Cow Peas matured no crop at all, some of them not even blooming. Of the other varieties, many failed to ripen a full crop for the same reason. It was noticed throughout the season that the foreign varieties were more backward in development than nearly related varieties that were home-grown, this lateness in many cases being the only point of distinction between a native and a foreign variety. The varieties from Venezuela and France were noted as being relatively later than those from Germany.

Of the "Wax" beans, the Golden Butter Wax may be mentioned as one of the very best. It was earlier in arriving at edible maturity than any other. The pure golden yellow pods are very fleshy and

tender, and though not long, are produced abundantly and the crop is ripened up uniformly. Many of the "Wax" varieties are neither vigorous nor productive, and the pods seem to be more liable to the attack of fungoid diseases than the pods of other varieties. The one great point of superiority of all "Wax" varieties is in their tender yellow pods.

Among the earlier of other varieties becoming edible within a few days of the Golden Butter Wax may be mentioned Dwarf Black Wax, the French variety Haricot Saumon du Mexique, Gray Seeded Purple Speckled, Emperor William, White Flageolet, Dwarf Golden Wax, Dwarf Cranberry, Early Feejee and French Emile. All of these are bush varieties, and all produced edible pods before July 15, the pole varieties being for the most part later by about two weeks. Among the earlier of the pole varieties are Marblehead Champion, Mont D'Or, Algiers, Transylvanian Butter, Blue Podded, the French varieties Haricot rouge d'Orleans and Haricot rouge de Chartres, and the German varieties Stangen Schwertbohne and Butter Brechbohne. All of these furnished edible pods before August 1.

Among the more prolific pole beans are Case Knife, Concord, Mottled Cranberry, Kentucky Wonder, Southern Prolific, Round White Princess and the French beans Haricot Comtesse de Chambord, Haricot de Liancourt, and Haricot Intestin. The most prolific bush beans are Turtle Soup, Newington Wonder, Hundred for One, Refugee, Galega, Crystal Wax, True White Pea, White Marrow and Mexican Tree. This last was one of the novelties sent out by seedsmen for the first time last spring. It seems to be a prolific form of the old fashioned Navy or Pea Bean. With us it is much later and more prolific than the ordinary Navy bean. In other respects the two are indistinguishable. Though our seed was obtained from three independent sources, in each case only about half the crop ripened before the plants were killed by the frost. Other statistics in regard to the different varieties are given in the table below. The names underscored are understood to be synonyms of the numbered name preceding them. The numbers refer to the number under which the variety is described in the classification following:

Beans.

Variety.	Number of seeds planted.	Date of planting.	First vegetation.	First bloom.	Pods edible.	Green beans edible.	Duration of edible maturity, days.	First ripe seed.	Number of plants harvested.	Per cent of unripe pods.	Average number pods per plant.	Average number beans per plant.	Average number beans per pod.	Weight of crop, ounces.	Average weight of crop per plant, ozs.
1. Case Knife	24	May 24	June 8	July 19	Aug. 7	Aug. 13	35	Sept. 1	9	28.8	24.65	112.90	4.57	13.76	2.15
Dutch Case Knife	24	May 24	June 9	July 23	Aug. 7	Aug. 13	35	Sept. 5	9	38.0	20.45	88.79	4.34	10 16	1.82
Haricot de Liancourt	24	May 24	June 7	July 23	Aug. 11	Aug. 17	31	Sept. 5	7	27.7	45.42	180.30	3.97	17.98	3.55
Stangenschwertbohne	23	May 24	June 7	July 7	July 25	Aug. 6	26	Aug. 20	11	7.7	9.46	36.13	3.82	6.00	.59
2. Haricot de Soissons blanc	24	May 24	June 12	July 21	Aug. 7	Aug. 14	28	Sept. 11	7	40.0	7.85	28.08	3.57	3.46	.82
3. White Scimetar	50	May 25	June 4	July 3	July 16	Aug. 2	26	Aug. 13	27	......	6.56	22.48	3.43	7.55	.28
Emperor William	50	May 25	June 5	July 2	July 14	July 30	26	Aug. 11	33	......	3.52	10.97	3.12	3.84	.12
Earliest White Seeded Frame	50	May 25	June 4	July 4	July 20	Aug. 3	25	Aug. 21	28	......	9.89	42.14	4.26	12.14	.43
Haricot de Soissons nain.	50	May 25	June 5	July 4	July 23	Aug. 6	25	Aug. 20	12	......	9.42	29.75	3.16	4.58	.38
Haricot Sabre nain de Holland	50	May 25	June 4	July 4	July 16	July 30	35	Aug. 17	26	......	6.42	22.15	3.45	7.02	.27
Haricot commun plat	50	May 25	June 4	July 9	July 23	Aug. 6	30	Aug. 20	13	......	10.39	37.31	3.59	5.47	.42
Krup Schwertbohne	34	May 25	June 5	July 9	July 24	Aug. 3	29	Aug. 23	10	......	3.60	11.60	3.22	1.27	.13
Fruehe Weisse Schwertbohne	24	May 24	June 6	July 9	July 26	Aug. 6	26	Aug. 23	10	......	12.30	56.80	4.63	6.17	.62
Butter Brechbohne No. 5	20	May 24	June 7	July 11	July 27	Aug. 6	26	Aug. 20	10	20.7	8.20	30.28	3.69	3.35	.42
Butter Brechbohne No. 7	24	May 24	June 7	July 13	July 31	Aug. 6	30	Aug. 30	5	8.7	4.60	14.02	3.05	.71	.15
4. Very Long-podded Sugar	24	May 24	June 6	July 20	Aug. 9	Aug. 13	33	Sept. 19	7	47.1	24.85	145.60	5.86	8.08	2.18
5. Yellow-podded White Wax	24	June 14	June 19	Aug. 7	Aug. 20	....	22	Sept. 26	10	66.	10.60	36.51	3.44	2.82	.83
Yellow-podded White-seeded Sugar	24	May 24	June 12	July 19	Aug. 4	Aug. 11	26	Aug. 30	2	17.1	20.50	109.70	5.35	2.33	1.40
6. Algiers	24	May 24	June 6	July 9	July 25	Aug. 2	33	Aug. 24	14	6.5	8.79	32.47	3 70	9.24	.71
Stangen Fleischbohne mit gelben Schoten	14	May 24	June 5	July 2	July 25	Aug. 2	33	Aug. 24	14	7.7	9.21	36.40	3.95	8.68	.67
7. Marshall	24	May 24	June 6	Aug. 11	Aug. 24	Sept. 1	26	Sept. 22	23	62.7	22.86	107.96	4.94	17.11	2.06
8. Blue Podded	24	May 24	June 6	July 6	July 25	Aug. 3	26	Aug. 20	15	......	10.67	55.67	5.22	11.81	.79
9. Giant Red Wax	24	May 24	June 6	July 17	Aug. 3	Ang. 8	39	Sept. 4	14	27.4	19.29	101.15	5.24	16.47	1.62
Giant Wax	24	May 24	June 6	July 23	Aug. 4	Aug. 8	38	Sept. 4	18	15.0	18.55	86.96	4.69	21.30	1.39
10. Transylvanian Butter	24	May 24	June 6	July 7	July 28	Aug. 2	23	Aug. 25	22	......	6.00	24.78	4.13	10.09	.46
11. Newington Wonder	50	May 25	June 4	July 3	July 25	Aug. 3	26	Aug. 20	49	......	12.98	65.36	5.04	20.60	.42
Early Snap Short	50	May 25	June 4	July 12	July 25	Aug. 3	27	Aug. 21	46	......	15.11	82.32	5.45	22.53	.49
12. Gray Seeded	50	May 25	June 4	July 3	July 13	July 31	24	Aug. 13	28	......	6.58	27.88	4.34	9.28	.33
13. Haricot rouge de Chartres	24	May 24	June 6	July 7	July 28	Aug. 6	25	Aug. 25	13	......	5.23	21.77	4.16	2.75	.21
14. Turtle Soup	50	May 25	June 4	July 16	July 31	Aug. 7	23	Aug. 27	49	......	13.14	64.95	4.94	20.10	.41
Venezuelan No. 1	50	May 25	June 6	July 26	Aug. 13	Aug. 24	22	Sept. 19	25	35.5	20.27	109.05	5.38	13.12	.81
15. White Flageolet	50	May 25	June 4	June 30	July 13	Aug. 2	28	Aug. 13	26	......	10.77	34.61	3.21	9.03	.35
Improved Green Flageolet	50	May 25	June 4	July 6	July 21	Aug. 6	23	Aug. 20	4	......	2.75	7.00	2.55	.14	.04
Haricot Flageolet Blanc	50	May 25	June 4	July 4	July 18	Aug. 2	23	Aug. 17	35	......	7.34	19.74	2.69	6.07	.17
H. Flageolet blanc tres hatif d' Etampes	50	May 25	June 4	June 30	July 13	Aug. 2	26	Aug. 13	24	......	4.96	25.34	5.11	5.54	.23
H. Flageolet a grain vert	50	May 25	June 4	July 6	July 20	Aug. 3	25	Aug. 15	41	......	7.40	21.34	2.88	7.05	.22

BEANS—(*Continued.*)

VARIETY.	Number of seeds planted.	Date of planting.	First vegetation.	First bloom.	Pods edible.	Green beans edible.	Duration of edible maturity.	First ripe seed.	Number of plants harvested.	Per cent of unripe pods.	Average number pods per plant.	Average number beans per plant.	Aver ge number beans per pod.	Weight of crop, ounces.	Average weight of crop per plant.
H. Flageolet Chevrier a gr. toujours vert	50	May 25	June 2	July 6	July 20	Aug. 3	24	Aug. 20	24	......	11.42	37.34	3.27	7.12	.30
16. Haricot jaune tres hatif de Chalandray	50	May 25	June 5	July 2	July 17	Aug. 2	23	Aug. 10	17	......	8.18	24.48	2.99	4.09	.24
17. Red Kidney	50	May 25	June 6	July 7	July 26	Aug. 6	25	Aug. 23	47	......	6.89	22.38	3.25	20.88	.44
Red French Kidney	50	May 25	June 4	July 6	July 25	Aug. 6	20	Aug. 22	44	......	5.89	18.81	3.20	15.80	.26
18. **Canadian Wonder**	50	May 25	June 5	July 7	July 25	Aug. 6	27	Aug. 23	47	......	4.08	13.26	3.24	12.87	.27
Rose	50	May 25	June 5	July 10	July 28	Aug. 6	24	Aug. 27	46	......	4.87	16.37	3.36	15.70	.34
19. **Haricot Flageolet rouge**	50	May 25	June 6	July 6	July 23	Aug. 3	29	Aug. 24	35	......	9.23	25.77	2.79	17.28	.49
20. **Haricot chocolat**	50	May 25	June 4	July 3	July 18	Aug. 2	33	Aug. 17	35	......	9.46	30.34	3.21	11.00	.31
21. **Purple Flageolet**	50	May 25	June 4	June 30	July 12	July 30	29	Aug. 10	46	......	6.85	18.37	2.68	13.30	.29
22. Dwarf German Wax, Long	50	May 25	June 4	July 7	July 21	Aug. 1	21	Aug. 14	34	......	10.35	42.20	4.08	15.31	.45
Dwarf German Wax	50	May 25	June 4	July 7	July 20	Aug. 1	17	Aug. 13	35	......	9.11	34.53	3.79	10.93	.31
23. Flageolet Wax	50	May 25	June 5	July 3	July 17	Aug. 2	20	Aug. 21	42	......	3.43	10.91	3.18	7.51	.18
Red Flagolet	50	May 25	June 5	July 3	July 18	July 31	21	Aug. 13	44	......	5.66	19.25	3.40	15.63	.36
Haricot Flageolet beurre nain	50	May 25	June 5	July 3	July 19	July 31	18	Aug. 21	46	......	3.06	8.96	2.86	6.42	.14
Violet Krup Wachs-bohne mit gelben Schoten	17	May 25	June 6	July 6	July 18	Aug. 2	19	Aug. 17	9	......	7.11	23.12	3.25	3.39	.38
24. Best of All	50	May 25	June 4	July 2	July 16	Aug. 1	26	Aug. 17	43	1.0	7.05	25.46	3.61	17.18	.40
McMillan's Prolific	40	May 25	June 5	July 2	July 16	July 30	23	Aug. 14	36	......	10.03	35.39	3.53	20.64	.57
Sion House	44	May 25	June 5	July 3	July 16	Aug. 1	28	Aug. 17	30	......	10.14	36.61	3.61	14.21	.47
Haricot turc	50	May 25	June 4	July 10	July 31	Aug. 6	23	Aug. 21	30	......	12.37	45.30	3.66	20.81	.69
25. Krupbohne	12	May 25	June 5	July 7	July 24	Aug. 2	27	Aug. 23	10	......	15.50	55.30	3.57	10.16	1.02
26. Haricot Suisse rouge	50	May 25	June 5	July 10	July 25	Aug. 2	30	Aug. 23	36	......	6.14	18.05	2.94	9.66	.27
Venezuelan No. 9	50	May 25	June 5	July 7	July 24	Aug. 1	30	Aug. 24	37	5.0	8.09	27.44	3.39	15.03	.43
27. Early Fejee	50	May 25	June 4	June 30	July 13	Aug. 2	45	Aug. 17	39	......	9.02	23.86	2.65	13.76	.35
28. Marblehead Champion	24	May 24	June 7	July 6	July 28	Aug. 4	23	Aug. 23	20	......	7.70	31.20	4.05	10.69	.53
29. White Kidney	50	May 25	June 5	July 16	Aug. 1	Aug. 10	23	Sept. 4	8	......	14.87	47.75	3.21	8.36	1.04
Long White Canterbury	44	May 25	June 5	July 6	July 20	July 30	21	Aug. 14	13	......	8.15	29.85	3.66	7.13	.55
Haricot Suisse blanc	50	May 25	June 6	July 17	Aug. 2	Aug. 9	25	Sept. 1	12	......	13.50	42.75	3.17	10.34	.86
30. Krup Mogenheuser bohne	24	May 25	June 5	July 11	Aug. 2	Aug. 9	23	Sept. 4	9	......	11.78	38.55	3.20	5.01	.56
31. Haricot due St. Esprit	50	May 25	June 5	July 6	July 23	Aug. 3	28	Aug. 25	12	......	7.33	22.75	3.10	5.01	.42
32. White Valentine	50	May 25	June 4	July 6	July 18	Aug. 1	35	Aug. 21	7	......	16.72	61.72	3.69	3.53	.50
Haricot intestin	24	May 24	June 7	July 23	Aug. 4	Aug. 17	26	Sept. 4	8	......	26.00	110.12	4.24	9.49	1.19
33. Long Yellow Six Weeks	50	May 25	June 5	July 2	July 16	July 31	21	Aug. 10	48	......	4.52	15.09	3.34	11.18	.23
Krupbohne No. 21	26	May 25	June 5	July 2	July 17	Aug. 1	20	Aug. 13	25	......	11.88	43.64	3.67	15.17	.61
Haricot flageolet jaune	50	May 25	June 6	July 4	July 16	Aug. 2	21	Aug 13	39	......	6.28	23.72	3.77	14.74	.38
34. Venezuelan No. 5	50	May 25	June 5	July 4	July 14	July 30	20	Aug. 8	27	......	4.93	15.07	3.06	6.77	.25
35. Haricot Suisse ventre de biche	50	May 25	June 4	July 4	July 23	Aug. 1	25	Aug. 20	45	......	6.51	27.57	4.23	13.09	.29

36. Dwarf Russian	50	May 25	June 5	July 9	July 23	Aug. 2	18	Aug. 22	44	......	3.91	12.79	3.27	8.78	.20
37. Ne plus ultra	50	May 25	June 4	July 2	July 17	Aug. 1	22	Aug. 8	49	......	6.31	26.08	4.14	15.83	.32
38. Kentucky Wonder	24	May 25	June 6	July 19	Aug. 1	Aug. 13	23	Aug. 27	20	......	14.90	103.20	6.92	27.33	1.37
39. Early Dun Colored	50	May 25	June 5	June 30	July 16	Aug. 1	25	Aug. 9	38	......	6.26	23.11	3.68	14.88	.39
Dark Dun	50	May 25	June 5	July 3	July 19	Aug. 1	42	Sept. 4	38	......	7.95	26.38	3.32	12.84	.34
Krupbohne mit gruenen Schoten	15	May 25	June 5	July 3	July 18	Aug. 1	84	Aug. 14	14	......	13.93	55.00	3.95	10.76	.77
40. Haricot flageolet noir	50	May 25	June 5	July 10	July 24	Aug. 6	27	Aug. 24	29	......	12.31	54.21	4.40	16.44	.59
Haricot noir hatif de Belgique	50	May 25	June 4	July 3	July 18	Aug. 1	22	Aug. 13	45	......	7.71	25.65	3.33	12.87	.29
Schwarze Negerbohne	34	May 25	June 4	July 7	July 24	Aug. 6	29	Aug. 23	28	......	11.21	46.25	4.12	12.24	.44
41. Golden Butter Wax	50	May 25	June 4	June 29	July 12	July 27	18	Aug. 3	43	......	4.46	13.65	3.06	7.55	.18
Haricot de' Alger noir nain	50	May 25	June 5	July 4	July 20	July 30	17	Aug. 10	45	......	4.67	15.36	3.29	8.82	.20
Haricot d' Alger noir nain a longue cosse	50	May 25	June 5	July 3	July 18	July 30	19	Aug. 13	47	......	4.91	15.28	3.11	9.59	.20
42. Red Valentine	50	May 25	June 5	July 4	July 16	Aug. 2	26	Aug. 20	43	.....	8.42	26.07	3.10	15.31	.36
43. Tullmer's Early	40	May 25	June 6	July 7	July 20	Aug. 2	38	Aug. 23	7	......	12.72	41.15	3.24	5.22	.75
Haricot Suisse sang de boeuf	50	May 25	June 5	July 7	July 31	Aug. 6	21	Aug. 22	43	......	6.58	21.63	3.29	15.34	.36
44. Early Mohawk	50	May 25	June 5	July 2	July 14	July 31	23	Aug. 9	42	......	3.90	14.64	3.75	10.12	.24
Purple Speckled	44	May 25	June 6	July 2	July 13	July 31	24	Aug. 11	41	......	4.44	17.00	3.83	11.39	.28
Ganz fruehe Ilsenburger Bohne	21	May 25	June 6	July 7	July 23	Aug. 17	25	Aug. 25	13	......	11.66	34.16	2.92	8.71	.69
45. Refuge	50	May 25	June 5	July 11	July 31	Aug. 9	27	Aug. 30	46	......	13.93	43.49	3.12	25.75	.56
46. Gallega	50	May 25	June 5	July 17	Aug. 3	Aug. 13	24	Sept. 4	50	......	13.28	55.86	4.21	34.71	.69
47. Black Speckled	50	May 25	June 5	July 12	Aug. 2	Aug. 9	25	Sept. 4	45	......	9.40	37.26	3.97	23.81	.53
48. Navy or Pea	50	May 25	June 4	July 9	July 25	Aug. 3	33	Aug. 20	40	......	9.82	38.72	3.94	9.59	.24
Mexican Tree	50	May 25	June 2	July 23	Aug. 13	Aug. 24	28	Sept. 11	39	22.9	17.91	76.36	4.27	15.94	.53
Mexican or California Tree	50	May 25	June 4	July 28	Aug. 17	Aug. 25	33	Sept. 19	30	59.5	22.37	101.65	4.54	7.58	.62
California Branch	50	May 25	June 4	July 30	Aug. 17	Aug. 25	33	Sept. 19	35	46.4	22.38	95.37	4.26	11.81	.63
Haricot Comtesse de Chambord	24	May 24	June 6	July 23	Aug. 6	Aug. 17	44	Sept. 5	5	24.8	66.00	352.10	5.33	6.95	1.85
49. White Medium	50	May 25	June 4	July 7	July 18	Aug. 1	35	Aug. 13	34	......	12.44	41.91	3.36	13.76	.32
Haricot rond blanc commun	50	May 25	June 4	July 6	July 24	Aug. 3	29	Aug. 14	45	......	14.13	54.06	3.82	7.34	.49
Venezuelan No. 6	50	May 25	June 4	July 28	Aug. 14	Aug. 20	28	Sept. 19	38	17.3	14.08	54.20	3.85	12.70	.41
50. White Marrow	50	May 25	June 4	July 7	July 24	Aug. 1	20	Aug. 20	17	......	15.47	55.70	3.60	17.99	1.03
Marrow	50	May 25	June 4	July 7	July 24	Aug. 1	31	Aug. 20	25	....	15.20	61.64	4.50	20.14	.81
Large White Marrow	50	May 25	June 5	July 9	July 24	Aug. 2	24	Aug. 17	21	......	18.77	59.76	3.18	16.58	.79
White Cornhill	50	May 25	June 4	July 9	July 23	Aug. 3	28	Aug. 20	27	......	11.63	39.52	3.40	15.80	.59
Krupbohne No. 25	50	May 25	June 4	July 4	July 16	July 30	22	Aug. 13	13	......	10.00	37.85	3.79	7.48	.58
51. Round White Princess	24	May 24	June 7	July 20	Aug. 7	Aug. 13	23	Sept. 4	1	......	47.00	295.00	6.28	2.54	2.54
True White Pea	50	May 25	June 4	July 12	Aug. 2	Aug. 10	28	Sept. 1	20	......	20.40	68.45	3.36	13.02	.65
Haricot Princesse	24	May 24	June 5	Aug. 1	Aug. 13	Aug. 20	22	Sept. 19	3	......	43.33	233.65	5.39	4.83	1.61
Stangen Perlbohne	24	May 24	June 7	July 9	July 30	Aug. 9	21	Aug. 25	2	....	9.00	46.00	5.11	.81	.41
Krup Perlbohne	34	May 25	June 4	July 7	July 21	Aug. 1	21	Aug. 17	15	......	11.00	39.06	3.55	4.90	.33
52. Holsteiner Bohne	37	May 25	June 5	July 4	July 21	Aug. 2	21	Aug. 15	11	......	6.96	21.91	3.15	2.26	.21
53. Haricot saumon du Mexique	24	May 24	June 5	July 2	July 14	July 30	20	Aug. 15	19	......	4.26	15.84	3.72	5.04	.27
54. Intermediate Dun Cranberry	50	May 25	June 6	July 10	July 23	Aug. 2	21	Aug. 20	48	......	7.56	20.73	2.74	15.83	.83
55. Haricot rouge d'Orleans	24	May 24	June 6	July 6	July 18	July 30	24	Aug. 13	17	......	5.85	22.59	4.00	5.15	.30
56. Hundred for One	50	May 25	June 4	July 4	July 17	Aug. 1	28	Aug. 15	21	......	18.95	72.57	3.83	8.85	.42
Krupbohne No. 12	41	May 25	June 4	July 4	July 17	Aug. 1	28	Aug. 14	23	......	19.00	73.35	3.86	10.93	.48
57. Round Yellow Six Weeks	50	May 25	June 5	July 3	July 16	July 31	21	Aug. 10	49	......	5.80	24.49	4.23	16.40	.34
58. Southern Prolific	24	May 24	June 6	July 24	Aug. 9	Aug. 21	18	Sept. 11	23	......	26.74	171.40	6.41	39.10	1.70
59. Black Negro	50	May 25	June 4	July 3	July 18	Aug. 1	26	Aug. 13	39	......	12.33	52.25	4.24	17.11	.44
60. Early China	50	May 25	June 4	July 4	July 17	Aug. 2	22	Aug. 17	21	......	5.62	19.00	3.38	6.38	.30
Adler Bohne	13	May 25	June 5	July 3	July 17	July 31	22	Aug. 20	11	......	....	....	....	4.73	.43
61. Yellow-eyed China	50	May 25	June 5	July 10	July 23	Aug. 2	19	Aug. 21	5	......	10.00	27.06	2.70	2.54	.51
62. Early Rachel	50	May 25	June 4	July 2	July 17	July 31	22	Aug. 9	47	......	5.64	20.53	3.64	14.57	.31
63. French Emile	50	May 25	June 4	July 2	July 14	July 30	23	Aug. 11	37	......	5.41	19.19	3.55	10.76	.29
Haricot Emile nain sans parchemin	50	May 25	June 4	July 30	July 14	July 30	23	Aug. 13	38	......	5.00	18.53	3.71	10.23	.27
64. Osborn's Forcing	50	May 25	June 5	July 3	July 17	Aug. 2	23	Aug. 9	47	......	6.51	24.30	3.73	14.92	.32
Osborn's Early Forcing	50	May 25	June 5	July 3	July 16	Aug. 2	29	Aug. 11	14	......	8.93	33.36	3.74	6.84	.49
65. White Wax	50	May 25	June 5	July 7	July 21	Aug. 1	19	Aug. 21	21	......	9.38	22.86	2.44	6.21	.30

BEANS — (*Continued*).

VARIETY.	Number of seeds planted.	Date of planting.	First vegetation.	First bloom.	Pods edible.	Green beans edible.	Duration of edible maturity.	First ripe seed.	Number of plants harvested.	Per cent of unripe pods.	Average number pods per plant.	Average number beans per plant.	Average number beans per pod.	Weight of crop, ounces.	Average weight of crop per plant.
White Round Wax	50	May 25	June 5	July 3	July 23	Aug. 1	28	Aug. 20	36	1.2	9.00	32.82	3.65	11.53	.32
White German Wax	50	May 25	June 5	July 7	July 21	July 30	21	Aug. 17	33	....	8.45	25.24	2.99	7.72	.23
Dwarf German Wax, White	50	May 25	June 4	July 9	July 23	Aug. 1	14	Aug. 20	25	.....	13.60	47.32	3.48	10.79	.43
Haricot beurre blanc nain	50	May 25	June 6	July 10	July 24	Aug. 1	17	Aug. 21	18	.....	7.61	23.06	3.03	4.09	.23
Krup Wachsbohne mit gelben Schoten	19	May 25	June 6	July 9	July 23	Aug. 1	14	Aug. 20	9	.....	15 23	52.90	3.48	4.12	.46
66. Ivory Pod Wax	50	May 25	June 4	July 9	July 24	Aug. 3	28	Aug. 23	34	......	4.73	14.79	3.12	3.99	.12
67. Lemon Pod, Wax	50	May 25	June 4	July 9	July 24	Aug. 1	32	Aug. 27	19	......	6.42	23.47	3.65	3.99	.21
68. Crystal Wax	50	May 25	June 4	July 10	July 24	Aug. 6	27	Aug. 20	38	......	15.21	54.71	3.60	11.32	.30
69. White Algerian Wax	24	May 24	June 4	July 14	Aug. 3	Aug. 11	33	Sept. 11	10	.....	32.00	106.50	3 33	14.53	1.45
70. Yellow Podded Princess (Benary)	24	May 24	June 13	Aug. 2	Aug. 14	Aug. 21	17	....	2	33.3	13.50	54.75	4.06	.67	.50
Yellow Podded Princess (*Sibley*)	24	May 24	June 13	Aug. 7	Aug. 20	Aug. 24	22	....	2	65.0	10.00	27.10	2.71	.14	.20
71. Boston Dwarf Wax	50	May 25	June 4	July 7	July 24	Aug. 2	16	Aug. 14	40	......	10.08	32.92	3.27	10.72	.27
72. Mont d'or	24	May 24	June 6	July 12	July 26	Aug. 4	25	Aug. 27	21	.....	10.39	50.81	4.89	13 76	.66
Stangen Wachsbohne mit gelben Schoten	24	May 24	June 6	July 11	July 27	Aug. 2	24	Aug. 27	15	......	8.93	50.94	5.70	9.59	.64
73. Dwarf Black Wax	50	May 25	June 4	July 2	July 14	July 30	23	Aug. 9	44	......	7.84	22.18	2.83	9.63	.24
Black Wax	50	May 25	June 4	July 2	July 14	July 30	19	Aug. 9	47	......	8.79	22.73	2.59	12.17	.26
74. Dwarf Mont d'or	50	May 25	June 5	July 6	July 18	July 31	27	Aug. 20	47	......	6.06	16.77	2.76	9.52	.20
75. Dwarf Golden Wax	50	May 25	June 5	July 2	July 16	July 31	23	Aug. 15	16	......	2.81	10.44	3.71	2.29	.14
D. M. Ferry & Co's. Golden Wax	50	May 25	June 4	July 3	July 14	July 30	24	Aug. 11	25	......	3.60	10.24	2.84	3.32	.13
76. Perl Reis Krupbohne	50	May 25	June 4	July 24	Aug. 10	Aug. 17	20	Sept. 4	25	......	29.16	122.00	4.18	10.02	.40
76. White Cranberry	24	May 24	June 12	July 30	Aug. 20	Sept. 4	30	Sept. 26	6	58.1	7.17	29.46	4.11	1.31	.52
78. Pale Dun Runner	24	May 24	June 9	Aug. 8	Aug. 23	Aug. 31	27	....	14	85.7	7.00	22.50	3.50	.81	.40
79. Princess Rose	24	May 24	June 7	July 16	Aug. 2	Aug. 11	28	Sept. 1	17	1.4	16.48	53.73	3.25	7.05	.42
80. Golden Cranberry	50	May 25	June 5	July 6	July 21	Aug. 3	34	Aug. 23	21	......	9.48	32.00	3.38	7.23	.34
Golden Drop	50	May 25	June 4	July 6	July 24	Aug. 2	31	Aug. 23	42	......	8.88	34.30	3.86	16.47	.39
Round Seeded Canary	16	June 14	June 23	Aug. 1	Aug. 13	....	......	....	1	.....	10.00	31.00	3 10	.32	.32
Krup Prinzessenbohne	17	May 25	June 6	July 6	July 24	Aug. 2	27	Aug. 25	6	8.3	6.00	13.82	2.30	1.16	.21
Haricot de la Chine jaune	50	May 25	June 8	July 12	July 26	Aug. 6	16	Aug. 27	2	......	10.50	37.00	3.52	.74	.37
81. Red Cranberry	24	May 24	June 7	Aug. 1	Aug. 13	Aug. 21	22	Sept. 19	15	23.8	20.93	49.75	4.55	8.82	.77
Boston Market Pole Cranberry	24	May 24	June 7	July 12	July 31	Aug. 7	35	Sept. 5	18	1.9	11.61	56.39	4.86	14.36	.81
82. Dwarf Red Cranberry	50	May 25	June 5	July 2	July 17	July 30	20	Aug. 15	44	......	4.32	13.34	3.09	7.16	.16
83. Indian Chief	24	May 24	June 7	July 20	Aug. 2	Aug. 11	33	Aug. 27	24	25.8	5.00	26.07	5.21	8.43	.47
Black Wax	24	May 24	June 7	July 18	Aug. 3	Aug. 17	39	Sept. 19	19	8.4	6.62	23.62	4.19	7.62	.44
German Wax	24	May 24	June 7	July 30	Aug. 11	Aug. 22	21	Sept. 19	18	35.3	3.77	11.08	2.93	2.19	.19
Haricot beurre du Mont d'or	24	May 24	June 8	July 27	Aug. 11	Aug. 20	31	Aug. 31	7	18.2	15.72	70.90	4.51	5.82	1.02
Haricot d'Alger ou beurre noir	24	May 24	June 7	July 27	Aug. 11	Aug. 20	31	Sept. 19	10	44.7	14.30	40 91	2.86	5.47	.99
Strangen Wachsbohne	24	May 24	June 6	July 27	Aug. 9	Aug. 20	21	Sept. 11	17	29.5	2.58	7.85	3.03	1.34	.11
Schwarz Strangen Wachsbohne	13	May 24	June 7	July 28	Aug. 13	Aug. 20	22	Sept. 19	7	58.3	3.43	15.43	4.50	.67	.23
84. Horticultural	24	May 24	June 7	July 27	Aug. 8	Aug. 15	22	Sept. 19	17	17.6	3.65	11.73	3.22	3.53	.26

	Cranberry	24	May 24	June 8	July 16	July 28	Aug. 7	23	Sept. 11	19	......	5.58	16.00	2.87	7.05	.37
	Haricot de Prague marbre	24	May 24	June 7	July 10	Aug. 2	Aug. 8	28	Sept. 1	14	......	6.50	20.78	3.20	5.29	.38
85.	Intermediate Horticultural	50	May 25	June 5	July 2	July 16	July 30	21	Aug. 13	48	......	2.50	8.21	3.28	6.95	.14
	Dwarf Cranberry	50	May 25	June 5	July 3	July 13	July 30	24	Aug. 13	46	......	3.85	12.59	3.27	10.09	.22
86.	Concord	24	May 24	June 11	July 23	Aug. 9	Aug. 20	23	Sept. 19	1	39.3	28.00	97.20	3.47	1.34	2.21
87.	Mottled Cranberry	24	May 24	June 7	July 18	Aug. 2	Aug. 10	30	Sept. 4	2	......	17.00	75.00	4.41	3.00	1.50
88.	Schwarzbunte bohne	19	May 25	June 5	July 3	July 20	July 30	17	Aug. 17	13	......	11.98	37.54	3.15	5.47	.42
89.	Scarlet Runner	24	May 25	June 7	July 6	....	Aug. 3	......	Aug. 27	17	4.8	14.76	39.79	2.69	28.75	1.78
	Carter's Champion Runner	24	May 25	June 8	July 9	....	Aug. 1	......	Aug. 27	3	......	18.67	51.33	2.74	6.35	2.12
	Searles's Carter's Champion	22	May 20	June 6	July 4	....	Aug. 13	......	Aug. 25	4	27.8	4.50	13.50	3.00	1.62	.56
	Haricot d'Espagne rouge	24	May 25	June 6	July 4	....	July 30	......	Aug. 25	9	63.7	13.78	37.36	2.71	5.25	1.61
	Tuerkenbohne	24	May 25	June 5	July 3	....	Aug. 3	......	Aug. 25	11	18.0	4.55	9.76	2.15	3.17	.35
90.	Painted Lady	24	May 25	June 6	July 4	....	Aug. 6	......	Sept. 5	20	59.8	5.35	15.18	2.84	4.37	.54
91.	White or Dutch Runner	24	May 25	June 7	July 4	....	Aug. 6	......	Aug. 25	11	25.0	27.3	59.02	2.85	22.57	2.74
	Giant White	20	May 25	June 7	July 4	....	Aug. 6	......	Aug. 27	8	29.0	3.87	7.75	2.00	1.80	.32
	Haricot d'Espagne blanc	24	May 25	June 7	July 7	....	Aug. 6	......	Sept. 11	1	53.3	15.00	45.00	3.00	.99	2.12
	Weisse Tuerkische Bohne	9	May 25	June 6	July 9	....	Aug. 23	......	....	7	97.2	15.63	57.04	3.67	.39	2.01
92.	Large White Lima	14	June 14	June 25	Aug. 24	....	....	......	....	1	100.0	....	....	....	....	....
93.	Small White Lima	24	May 24	June 11	July 30	....	Sept. 19	......	....	8	85.7	62.00	151.03	2.44	3.00	2.62
94.	Red Lima	24	May 25	June 4	July 17	....	Aug. 24	......	Sept. 19	8	60.2	42.75	80.78	1.89	8.92	2.80
95.	Speckled Lima	24	June 14	June 22	Aug. 8	....	Sept. 19	......	....	9	100.0	....	....	....	....	....
86.	French Yard Long	36	May 25	June 11	Aug. 10	....	Aug. 31	......	Sept. 19	11	......	.64	3.45	5.43	.18	.02
97.	Chinese	100	May 25	June 7	July 31	....	....	......	Sept. 11	81	......	....	....	....	....	....
98.	Azuki (from Japan)	51	May 25	June 9	Aug. 13	....	....	......	....	31	......	....	....	....	....	....
99.	Soja hispida d'Etampes	100	May 25	June 7	July 28	....	....	......	Sept. 26	23	......	150.95	294.95	1.95	35.47	1.54
100.	Yellow Soja	100	May 25	June 8	July 21	....	....	......	Sept. 26	21	......	82.42	155.50	1.89	17.18	.82
	Soja	100	May 25	June 9	Aug. 13	....	....	......	....	15	100.0	....	....	....	....	....
	Green Soja	100	May 25	June 7	Aug. 14	....	....	......	....	39	100.0	....	....	....	....	....
	Daizu (from Japan)	56	May 25	June 8	July 28	....	....	......	Sept. 26	5	......	89.80	136.40	1.52	2.36	.47
101.	Red Soja	100	May 25	June 11	July 19	....	....	......	Sept. 4	11	......	34.45	59.64	1.73	4.51	.41
102.	Soja hispida a grain noir	100	May 25	June 5	Aug. 13	....	....	......	....	40	100.0	....	....	....	....	....

VARIATION AND HYBRIDIZATION.

In harvesting the bean crop in 1882 we were surprised in several instances to find among the beans of the true type of the variety others that were of an entirely different type. Usually the variation was confined to the coloring of the seed often, however, it extended to the shape and size as well. As the seed from which the crop had been grown had in all cases been obtained from seedsmen, these variations were ascribed at the time to the impurity of the seed, especially as such impurity was in many cases manifest. The results of the present season's investigations now lead us to believe that the variations were in many cases the result of cross-fertilization.

All the seeds in the crop of 1882 that were in any way different from the regular type of the variety were carefully sorted out and kept separately, and were planted as separate varieties the present season. The seed of the well established varieties that were planted this year was for the most part station grown, and had been carefully selected to what was believed to be the true type of the variety. In many cases this seed has given in the crop results that were more unlooked for than the variations of the preceding year.

Below are enumerated all the variations that have come under our notice.

Best of All.—This is a bush bean, oblong, slightly kidney form, usually somewhat flattened sidewise, light brown mottled and streaked with dull red, and with a yellow ring about the eye. In the crop of 1882 there appeared several beans of the same general shape, but colored differently, in that the dull red color was very much increased, so much so as to almost entirely cover the bean, leaving only small flecks here and there of the light brown color. These were sorted out and planted separately, but in the crop of 1883 gave almost entirely beans of the original color, while in the crop from the pure type of seed there were about the same number of beans that were off type as there had been the previous season. Numerous cases were also noticed where one-half of the bean would be properly colored and the other half almost entirely dull red.

Boston Dwarf Wax.—A low bush variety with beans of medium size, varying in color from dark dun to dark brown, with a black ring around the eye, oblong, slightly kidney form, slightly flattened sidewise, rarely slightly compressed on the ends. From this variety a larger form mottled in two shades of dark brown was selected, and when planted separately in 1883 produced a crop that was true to seed with the exception that in about one-half the crop the mottled character of the seed was largely lost.

Canadian Wonder.—A tall bush variety, beans oblong, quite strongly kidney form, flattened sidewise, usually strongly compressed on the ends, very dark red. In 1882 the crop was entirely uniform, but in 1883 one plant produced beans slightly smaller in size, and of a dark purplish, almost black, color, obscurely marked with small greenish gray flecks which are inclined to form broken rings concentric with the eye. In 1882 it was planted in close proximity to a small black variety, the Dwarf Mont d'Or. Its other near neighbors were either red or speckled with red.

Concord.—A pole variety, the beans of which are medium or rather large in size, irregularly globose, scarcely oblong, slightly compressed

at the ends, eye plane or slightly protuberant, the half of the bean about the eye light brown or dun splashed with dull red, the remainder white with a veiny net-work and an occasional spot of dun or red. From this variety two forms were selected from the crop of 1882, marked respectively *a* and *b*.

(*a*.) Beans of the same size and shape as the true type, but with the light brown color almost entirely replaced by the dull red. These beans produced in 1883 a crop, nearly every bean of which was of the true type of the variety, forming an entirely parallel variation to that which occurred in the variety *Best of All* mentioned above.

(*b*.) Beans of the same color as the true type of the variety, but larger, oblong and slightly kidney shape. There were but three of these selected; two were planted and one was reserved for comparison. Of the two planted but one grew, and this produced beans entirely different from either the seed planted or the original variety from which it was selected. They may be described as oblong, quite strongly flattened sidewise, slightly kidney form, rarely slightly compressed at the ends, yellowish brown with darker markings, which are inclined to form broken rings concentric with the eye. None of the near neighbors of the Concord in 1882 at all resembled this variation in color.

Horticultural.— A pole variety, beans irregularly globose, sometimes slightly oblong, occasionally compressed on the ends, eye usually slightly protruberant, light brown or dun, usually variously spotted or striped with dark dull red. This bean was grown at the station in 1882 both under its proper name and under the synonym *Cranberry*. Those grown under the name *Cranberry* were from seed that was apparently mixed, and at harvest time no less than four forms were selected, all of which were different from any other known variety. These were labeled *a*, *b*, *c* and *d* and were planted in 1883, and results noted as follows:

(*a*.) An almost spherical bean, slightly smaller than the true type, light dun color with numerous small, angular, very dark, almost black spots. It produced beans entirely true to its own type.

(*b*.) A bean slightly smaller than the true type of the variety, quite strongly flattened sidewise, so as to be somewhat lenticular, light dun, almost covered with dark points, giving it a grayish ground color, with one or more dark bands or portions of bands concentric with the eye, running through the centre of each side. This produced for the most part beans true to its own type; some were more inclined to be oblong in shape, and in a few all the colors were of a lighter shade, this last perhaps due to incomplete ripeness.

(*c*.) A bean of medium size, slightly oblong, with rounded ends, not kidney shape, scarcely flattened sidewise, white, nearly completely covered with dull mottled red blotches that are nearly spherical in form, and more or less confluent. This produced a crop about half of which were true to its own type; of the remainder the mottled character of the red blotches was much more marked in some and in others all except the portion about the eye was white. This last form approaching quite closely in general appearance the *Early China* variety.

(*d*.) A bean entirely like the true type of the variety except that the red color covers almost entirely the whole surface. It produced beans, all of which, with one or two exceptions, were of the true type of the

variety. It is a parallel variation to that already mentioned as occurring in the *Best of All* and *Concord* varieties.

Intermediate Horticultural. — A bush bean in many respects identical with the preceding, of which it is a dwarf form. The beans of this variety are, however, of a more oblong form. From this and from a synonymous variety called, *Dwarf Cranberry*, there were selected beans that were almost entirely covered with the dull red color. These produced in turn beans of the true type of the variety; another instance of the same kind of variation mentioned previously.

There was another form selected from the 1882 crop of the *Dwarf Cranberry*, beans about the same size as the true type, but oblong and of a purple color, more or less mottled with light brown. Some were almost entirely purple; others were not more than two-thirds purple. Six of these beans were planted, but only three produced mature plants and the beans from each of these three plants were entirely different. One bore irregularly globose dark purple, almost black beans, apparently identical with the "Wax" pole bean, *Indian Chief*. Another produced smaller beans, flattened sidewise and often compressed at the ends, finely mottled in various shades of brown, and often with a dark band or portion of a band passing along the side of the bean concentric with the eye. The third produced beans of the true *Intermediate Horticultural* type. The edible pods of these three plants were noted as greenish yellow in color, but the edible pods of the true *Intermediate Horticultural* are green, becoming splashed with crimson as they approach maturity.

Early Fejee. — A bush bean of medium habit but sending out long runners like a pole bean; beans oblong, quite strongly kidney form, if flattened sidewise, rarely compressed at the ends, varying from almost pure white to white mottled and streaked with various shades of dull blue and drab. From this variety there was selected in 1882 a form very similar in many respects, yet quite distinct; the beans of this form are of about the same size as the others, but not so strongly kidney form; in color white mottled with slaty gray, with one or more black bands or parts of bands passing along the sides of the bean concentric with the eye. These planted in 1883 furnished a crop entirely true to their own type. The plants and pods of the two forms are almost entirely similar.

Early Rachel. — A bush variety of medium habit, beans oblong, kidney form slightly flattened sidewise, not compressed on the ends, dark brown, white on one end and a dark ring about the eye. In the crop of 1882 a large portion of the beans were without the white ends. These were sorted out and planted separately in 1883, the results being as follows:

Those with white ends out of a total of 965 beans produced seven with no white on them. Those with no white ends out of a total of 1187 beans produced twenty-nine with white ends.

Galega. — A slender but very luxuriant bush variety, beans oblong, nearly cylindrical, rarely compressed at the ends, splashed and mottled with light brown or dun color. The crop from this variety in 1882 was entirely uniform in appearance but this year there appeared among those of the true type numerous beans of the same general shape but of a slightly larger size, almost entirely black, with faint purplish markings.

Giant Red Wax. — A pole variety, beans oblong, very broad, not kidney form, quite strongly flattened sidewise, rarely compressed on the ends, dark reddish brown. Last year the crop from this variety was entirely uniform and true to type, but this year only about one-third of the crop was of the true color. Of the remainder about one-half were black, and the remainder were a bright golden yellow. In 1882 a black variety was planted on one side, and a white variety on the other side of this variety.

Golden Cranberry. — A bush bean of medium size often with a distinct twining habit; beans nearly globular, very slightly oblong, eye plane or slightly protuberant, pale sulphur yellow with veiny markings and a faint pale bluish ring about the eye. From this variety there was selected in 1882 a form of about the same size as the true type, but oblong, slightly flattened sidewise and mottled in two shades of brown. From this form there were produced in 1883 no less than eleven distinct forms, as follows:

(*a.*) A small number true to the type selected.

(*b.*) Oblong, not kidney form, not flattened sidewise, not compressed at the ends, mottled in two shades of light brown or drab. In markings very similar to the last, but lighter in color.

(*c.*) A very few beans longer in proportion to the breadth than the two preceding, but like them mottled in different shades of brown. The colors more distinct from each other and different in shade from either of the preceding.

(*d.*) Same shape as the last, very dark, almost black, more or less distinctly marked with light yellowish brown, resembling quite closely in color the variety *Galega*.

(*e.*) Slightly oblong, often nearly spherical, not flattened sidewise, not compressed on the ends, light dun with a greenish cast.

(*f.*) Similar in form to the last, very light creamy brown with a reddish ring about the eye.

(*g.*) Quite large, oblong, usually somewhat flattened sidewise, sometimes compressed on the ends, pale slaty drab with a reddish ring about the eye.

(*h.*) Small, slightly oblong, often nearly spherical, bright brownish yellow.

(*i.*) Larger, oblong, slightly flattened sidewise, not compressed on the ends, dark brown.

(*j.*) Oblong, slightly flattened sidewise, slightly kidney shaped, often compressed at the ends, black.

(*k.*) The same form as the last, white.

The true variety produced in 1883 an entirely uniform crop of perfectly true beans. Its near neighbors in 1882 included for the most part black dark red, dun and speckled varieties, the influence of which, however, could not be definitely traced in the forms produced this year.

Indian Chief. — A pole variety, irregularly globose, occasionally flattened sidewise, more or less oblong, black inclining to purplish, eye usually protuberant. In 1882 the pods were yellow from the first, and the whole crop was true to type this year, however, the edible pods were noted as whitish green and only a small portion of the beans were true to type; the remainder were oblong, flattened sidewise, usually compressed at the ends into a quadrangular shape, dark

purplish brown almost black, indistinctly marked with fine, light brown blotches. One of the nearest neighbors of this bean in 1882 was the Horticultural, a light brown bean speckled with dull red. Its other near neighbors were the *French Yard Long* and *Kentucky Wonder*, both brown beans.

White Marrow.— A slender bush variety with a distinct tendency to twining, beans oblong, rarely slightly kidney form, not flattened sidewise or compressed at the ends, white with a veiny network. In this variety which showed no variations in 1882 there appeared the present season three well marked forms as follows :

(*a.*) One plant of quite different aspect from the rest, pods flatter and more slender and striated with purple, beans oblong, flattened sidewise, often compressed on the ends, sometimes slightly kidney form, shining black in color.

(*b.*) Beans of the same shape as the true variety, but mottled in two distinct shades of yellowish brown.

(*c.*) Beans elongated, flattened sidewise, rarely compressed on the ends, usually slightly kidney shape, slaty gray with a dull red ring about the eye.

The immediate neighbors of this variety in 1882 were all white beans.

Newington Wonder.— A slender bush variety, sending out slender barren runners; beans small, oblong, slightly kidney form, not flattened on the sides, usually compressed on the ends so that they appear quadrangular, light brown or dun colored, with a veiny network and a yellow ring about the eye. This bean, though showing no variation in 1882, has in 1883 produced the following distinct forms:

(*a.*) Entirely like the true form but with small black spots more or less numerous scattered over the surface of the bean. The same plant on which this form was found produced also beans of the true type.

(*b.*) Of the same size and shape as the true form in color varying from dark purple to light slaty drab finely dotted with light brown.

(*c.*) Somewhat larger and more kidney form than the preceding, not compressed at the ends, in color slaty purple, indistinctly dotted with light brown.

Pale Dun Runner. — A pole variety with purplish flowers, beans nearly globular, occasionally compressed at the ends, eye more or less protuberant, light brown or dun with a bright yellow ring about the eye, and a peculiar polished shining appearance. In the crop of 1883 one of the plants of this variety bore scarlet flowers of the same color as the Scarlet Runner, but unfortunately no pods were ripened. This variety was planted close to the Scarlet Runner in 1882, but at quite a distance in 1883.

Red Flageolet.— A medium growing bush bean with no twining habit, beans oblong, slightly kidney form, slightly flattened sidewise, usually more or less compressed on the ends, dark red shading almost to black. There was no variation in this bean in 1882, but in 1883 a form appeared that was entirely like the true form in shape and size, but in color dark purple, mottled with light brown, resembling in this respect very closely the variety *Refugee*.

Galega and *French Emile*, two similarly marked beans, were among the nearest neighbors of the *Red Flageolet* in 1882.

Scarlet Runner and White Runner.— These two varieties have been

grown for two seasons, and this year there were grown also a number of the foreign synonyms of both varieties. In all cases some plants with scarlet flowers and black and purple seeds have been found among the white varieties, and some plants with white flowers and seeds have been found among the scarlet varieties. Two other interesting variations have been noticed. The *Haricot d'Espayne rouge,* or French name for the *Scarlet Runner* produced some beans in which the black color was reduced to a few small angular black spots. The *Türkenbohne,* or German name for the *Scarlet Runner,* produced some of the brown and white beans of the *Painted Lady* type.

It may be remarked in conclusion that the parts of the flower of the bean are so arranged that a bee alighting on the lower petals causes the anthers to protrude from the end of the keel, and the pollen thus exposed may be easily brushed off by the bee and carried to some other flower, and cross-fertilization effected. At various times during the flowering season bumble bees were noticed at work on the bean flowers, always entering on the left hand side.

Classification.

The different varieties of bean ordinarily grown may be referred to seven more or less well marked species belonging to the natural order Leguminosæ. They may be somewhat popularly distinguished as follows:

1. *Phaseolus vulgaris, L.*—The ordinary Kidney bean, either dwarf or running. Leaves trifoliate, leaflets triangular, ovate, more or less hairy, flowers axillary, single or in clusters of two or three, white running through the various shades to dark purple. Pods of medium size, slender, smooth.

2. *Phaseolus multiflorus, Lam.*—The Scarlet Runner. In many respects similar to the last, distinguished by its tuberous roots, tall running habit of growth, well developed racemes of scarlet or white flowers and large rough pods. The cotyledons do not appear above ground in vegetation.

3. *Phaseolus lunatus, L.*—The Lima bean, always running, leaflets narrower, more halberd shape, often mottled in two shades of green, smoother than *P. vulgaris,* flowers white, small, pod very broad, flat, leathery, beans rather large, with peculiar lines radiating from the eye.

4. *Dolichos sesquipedalis.*—The Asparagus bean, always running, leaflets plainly halberd shaped, nearly smooth, flowers yellowish purple, very large, pods in pairs, cylindrical, very long, eighteen inches or more, beans small, kidney form, very distant in the pod.

5. *Dolichos* (*sinensis* ?)—The Southern Cow Pea, similar to the last, but distinguished by its dwarf form and shorter pods with the beans crowded in them.

6. *Vigna* (——— ?)—The Chinese bean, dwarf in appearance, resembling dwarf forms of the Kidney bean, flowers yellow, pods small, cylindrical, straight seeds small, hilum elongated.

7. *Soja hispida, Moench*—The Soja bean, not running, eighteen inches to two or more feet high, leaflets broadly oval, whole plant including pod covered with rusty brown hairs, flowers axillary, very minute,

white or purple pods short, straight, rarely containing more than two beans. The cotyledons after vegetation develop into leaves.

The varieties of the ordinary Garden or Kidney bean are so numerous as to make the advantages of some system of classification very apparent. The characters which seem to us to be of most use in forming such a classification are those obtained from the variation in size, shape and color of the ripe seed. This is a basis of the classification made by Martens in Germany,* which we have to some extent followed. The color of the edible pods and the presence or absence of a climbing habit are also of use in separating varieties. We have been entirely unable to obtain satisfactory characters from the leaves. While there is considerable variation in their size, form and color, such variations seem to be quite as likely to occur on the same plant or on different plants of the same variety, as upon different varieties. The flowers vary directly as the color of the beans; *i. e.*, white and light colored beans have white flowers; the darker beans have purplish flowers, varying in intensity with the color of the beans.

The following classification seems to hold tolerably well for the eighty-eight varieties we have grown, and we have founded the descriptions following upon it.

Phaseolus vulgaris, L. — The Kidney bean.

I. Seeds oblong, not more than twice as long as broad, flattened sidewise.

(*a.*) Very strongly flattened, usually strongly kidney shape.

* Seeds of uniform color.

† Seeds white, edible pods green. Four varieties: type, Case Knife.

†† Seeds white, edible pods greenish-yellow. One variety, Yellow Podded White Wax.

††† Seeds black, edible pods green. One variety, Algiers.

** Seeds variegated. Two varieties: type, Marshall.

(*b.*) Seeds strongly flattened, not kidney shaped. Two varieties: type, Transylvanian Butter.

(*c.*) Seeds moderately flattened, slightly or not at all kidney shape. Four varieties: type, Turtle Soup.

II. Seeds oblong, at least twice as long as broad.

(*a.*) Perceptibly flattened sidewise, often truncate at the ends.

* Seeds of uniform color.

† Edible pods green. Seven varieties: type, Canadian Wonder.

†† Edible pods yellow. Two varieties: type, Flageolet Wax.

** Seeds variegated. Five varieties: type, Early Feejee.

(*b.*) Seeds cylindrical or nearly so.

* Seeds white or in one case marked about the eye. Four varieties: type, White Kidney.

** Seeds of uniform color (not white).

† Edible pods green. Eight varieties, type, Long Yellow Six Weeks.

†† Edible pods yellow. One variety, Golden Butter Wax.

*** Seeds variegated. Six varieties, type, Refugee.

III. Seeds oblong, never more than twice as long as broad, often nearly spherical.

(*a.*) Seeds distinctly oblong, usually with rounded ends.

---

* Die Gartenbohnen. Ihre Verbreitung, Cultur und Benutzung, von Georg von Martens, Ravensburg, 1869, p. 24.

* Edible pods green.

† Seeds of uniform color. Twelve varieties, type, Navy or Pea.

†† Seeds variegated. Five varieties, type, Early China.

** Edible pods yellow or yellowish white, (wax varieties). Eleven varities, type, White Wax.

(*b.*) Seeds spherical or nearly so.

* Seeds of uniform color. Eight varieties, type, Red Cranberry.

** Seeds variegated. Five varieties, type, Horticultural.

The descriptionss are intended to be sufficient to simply identify the variety, and reference to fuller descriptions in our report for 1882 are given in all cases.

1. PHASEOLUS VULGARIS, *L.* The Kidney-bean.

I. Seeds oblong, not more than twice as long as broad, flattened sidewise.

(*a.*) Very strongly flattened, usually strongly kidney shape.

* Seeds of uniform color.

† Seeds white, edible pods.

No. 1. Case Knife. — A tall growing pole variety; pods flat, nearly straight, beans white with veiny markings, oblong, very broad, strongly kidney form ; full description First Report, 1882, p. 113, No. 51.

Syns. Dutch Case Knife ; Haricot de Liancourt, Haricot Sabre a rames ; Stangen schwertbohne, Deutsche Schwertbohne, Schneidebohne Weisse Säbelbohne, Sverd, Stangenbohnen, etc., etc.

No. 2. Haricot de Soissons blanc. — In most respects similar to the preceeding, but distinguished from it by the larger size of the ripe beans, and the very long flattened wrinkled pods.

No. 3. White Scimetar. — A strictly dwarf bush variety, seeds rather small, not so strongly flattened as the two preceding, slightly kidney-shaped. It may be considered a dwarf form of No. 1. Full description First Report, 1882, p. 105, No. 27.

Syns. Earliest White Seeded Frame, Emperor William; Haricot de Soissons nain, Haricot sabre nain de Hollande, Haricot commun plat ; Frühe Weisse Schwertbohne, Krup Schwertbohne, Butterbrechbohne.

No. 4. Very Long-Podded Sugar. — A tall growing pole bean with long wrinkled pods, seeds strongly kidney shape, distinguished from No. 1, by the relatively greater length and smaller size of the ripe seeds.

†† Seeds white; edible pods greenish yellow.

No. 5. Yellow-Podded White Wax.—A slender, moderately tall pole bean, ripe beans often with a yellowish cast; full description First Report 1882, p. 114, No. 53.

Syn. Yellow-Podded White-Seeded Sugar.

††† Seeds black; edible pods green.

No. 6. Algiers.—A slender, moderately tall, pole bean, with very broad, much wrinkled pods. Beans large, oblong, very broad, strongly flattened sidewise, kidney shape, often transversely bent by the wrinkling of the pod, jet black, shining.

Syn. Stangen-Fleischbohne mit gelben Schoten.

** Seeds variegated.

No. 7. Marshall. — A late tall growing pole bean, seeds rather large,

oblong, very broad, kidney form, strongly flattened sidewise, pale dun yellow striped with brighter yellow in rings concentric with the eye; full description First Report, 1882, p. 114, No. 52.

No. 8. Blue Podded — A slender, rather tall pole bean, chiefly characterized by the dark purple color of the pods; beans rather large, broad, flat kidney-shape, often transversely bent, light brown or dun, finely mottled with chocolate.

(*b.*) Seeds strongly flattened, not kidney shape.

No. 9. Giant Red Wax — A tall-growing pole bean, edible pods yellow, beans of medium size, not much longer than broad, dark reddish brown; full description First Report, 1882, p. 114, No. 54.

No. 10. Transylvanian Butter — A slender, moderately tall pole bean, edible pods whitish green marked with purple, shining, beans scarcely longer than broad, lenticular, pale dirty blue shading off into bluish dun color; full description First Report, 1882, p. 113, No. 50.

c. Seeds moderately flattened; slightly or not at all kidney-shaped.

No. 11. Newington Wonder — A bush bean sending out slender barren runners, edible pods light green, beans small, oblong, slightly kidney form, often compressed on the ends, light brown or dun color, with a veiny network and a yellow ring about the eye; full description, First Report, 1882, p. 100, No. 13.

Syn. Early Snapshorts.

No. 12. Grey Seeded — A low strictly dwarf bush bean. Edible pods pearl white, beans of medium size, oblong, usually compressed at the ends into quadrangular shape; brownish drab with veiny markings and a dark reddish ring about the eye.

No. 13. Haricot rouge de Chartres — A strictly dwarf bush bean from France, edible pods light green; beans of medium size, oblong, often compressed at the ends, bright red in perfectly ripened specimens, fading out to reddish brown in those not so ripe.

No. 14. Turtle Soup — A bush bean with a decided tendency to twining, edible pods wavy green, beans small, oblong, slightly kidney form sometimes compressed at the ends, jet black with a greasy appearance; full description, First Report, 1882, p. 100, No. 12.

Syns. Tampico, Negerbohne, Haricot negre, Frijoles brusquito, Brasilianische Reiserbohne, New Frijoles, Pois a negres, Pois violet, etc., etc — The bean Venezuelan No. 1 sent us by U. S. Consul Beach, from Puerto Cabello proved to be the Turtle Soup.

II. Seeds oblong, at least twice as long as broad.

(*a.*) Perceptibly flattened sidewise, often truncate at the ends.

* Seeds of uniform color.

† Edible pods green.

No. 15. White Flageolet.— A vigorous, strictly dwarf bush bean, beans of medium size, white, polished, usually slightly kidney shape, rarely compressed on the ends; full description First Report, 1882, p. 106, No. 29. The "green" flageolet varieties of H. flageolet a grain vert of the French do not prove to be stable in this country, and have consequently been included in the synonyms of this variety.

Synonyms.— Haricot flageolet blanc, Haricot flageolet blanc tres hatif d'Etampes, Improved Green Flageolet, Haricot flageolet a grain vert, Haricot flageolet Chevrier a grain toujours vert.

No. 16. Haricot jaune tres hatif de Chalandray—A French variety, not vigorous, strictly dwarf, beans rather small, slightly kidney

shaped, not compressed on the ends, dark yellowish brown, polished, usually somewhat lighter toward the end of the bean.

No. 17. Red Kidney. — A strictly dwarf bush bean of medium height; beans large, slightly kidney form, often compressed on the ends, light red changing to light brown; full description First Report, 1882, p. 112, No. 46.

Synonyms. Red French Kidney, Chilian.

No. 18. Canadian Wonder.— A rather tall, stout, though strictly dwarf bush bean; beans large, quite strongly kidney form, often compressed at the ends, very dark red; full description First Report, 1882, p. 112, No. 47.

Synonym. Rose.

No. 19. Haricot flageolet rouge — A strictly dwarf bush bean of medium height; beans rather large, slightly kidney form, rarely compressed on the ends, dark red. It is distinguished from No. 18 by the lighter color, slightly smaller size and relatively greater length of beans.

No. 20. Haricot Chocolat.— A strictly dwarf bush bean of medium height; beans of medium size, very slightly kidney form, rarely compressed on the ends, bluish slate color fading out to brownish slate color.

No. 21. Purple Flageolet.— A strictly dwarf bush bean of medium height, beans of medium size, very slightly or not at all kidney form. rarely compressed at the ends, dull dark purple, almost black; full description First Report, 1882, p. 113, No. 49.

†† Edible pods yellow.

No. 22. Dwarf German Wax, Long.— A strictly dwarf, rather vigorous bush bean; beans kidney form, occasionally compressed at the ends, white with veiny markings, polished; full description First Report, 1882, p. 106, No. 31.

Synonym. Dwarf German Wax.

No. 23. Flageolet Wax — A strictly dwarf bush bean, rather above medium height, beans slightly kidney form, occasionally compressed at the ends, deep dark red. Distinguished from No. 19 by its yellow pods.

Synonyms. Red Flageolet, Haricot flageolet beurre nain; Violet Krup Wachs-bohne mit gelben Schoten.

** Seeds variegated.

No. 24. Best of All.— A vigorous, strictly dwarf, bush bean, edible pods light green, becoming striped with red as they approach maturity; beans of medium size, very slightly kidney form, rarely compressed on the ends, light brown, splashed and streaked with dull red, a yellow ring about the eye. Occasional beans are nearly entirely covered with the dull red color; full description First Report, 1882, p. 108, No. 36.

Synonyms. McMillan's Prolific, Sion House, Haricot turc.

No. 25. Krup Bohne.— A variety sent from Germany under the indefinite name dwarf bean. A vigorous, strictly dwarf bush bean, edible pods green, beans rather large, very slightly kidney shape, rounded on the ends, light brown, splashed and streaked with dark reddish purple, a dark yellow ring about the eye.

No. 26. Haricot Suisse rouge. — A moderately vigorous, strictly dwarf bush bean, edible pods whitish green, beans of medium size,

very slightly kidney form, rounded on the ends, light reddish brown splashed and mottled with dull red; occasional beans are almost entirely covered by the dull red splashings.

Synonym. The bean received from U. S. Consul Beach, as Venezuelan No. 9, proved to be this variety.

No. 27. Early Feejee — A vigorous bush bean, sending out long runners like a pole bean, edible pods grayish green sometimes marked with purple; beans quite strongly kidney form, rarely compressed on the ends, varying from almost pure white to white mottled and streaked with various shades of dull blue and drab; full description First Report, 1882, p. 109, No. 37.

Synonym. White's Early.

No. 28. Marblehead Champion — A rather tall growing pole bean, edible pods whitish green with purple dorsal sutures, beans of medium size, slightly kidney form, frequently compressed at one end, light brown or dun mottled with chocolate; full description First Report, 1882, p. III, No. 43.

(*b.*) Seeds cylindrical or nearly so.

* Seeds white or in one case marked about the eye.

No. 29. White-Kidney — A rather tall, strictly dwarf, bush bean, edible pods green, beans rather large, quite strongly kidney form, rarely compressed at the ends, white with veiny markings, polished; full description First Report, 1882, p. 109, No. 38.

Synonyms. Kidney, Large White Kidney, Royal Dwarf, Long White Canterbury, Haricot Süisse blanc, Fagioli a cannelini, Weisse Dattelbohne, etc., etc.

No. 30. Krup Mogenhäuserbohne — A German variety that is scarcely distinct from the last, but as the vines send out barren runners we have given it a separate place.

No. 31. Haricot du St. Esprit — A strictly dwarf bush bean closely resembling in growth No. 29, edible pods green; beans rather large, quite strongly kidney shape, rarely compressed at the ends, white with veiny markings, polished, about the eye dark brown markings in fanciful resemblance to a human skeleton or a bird with out stretched wings, whence its

Synonyms. Haricot a la religieuse, Haricot a l'Aigle, Faginlo dell Aquila, Muttergottes Stockbohne, Adlerbohne. (The bean sent us from Germany as Adlerbohne proved to be the Early China.)

No. 32. White Valentine.— A bush bean with a distinct twining habit, edible pods green, beans rather small, scarcely or not at all kidney form, often compressed on the ends, dirty white with veiny markings, polished. On many of the beans the skin is wrinkled as if it were too large for the bean.

Synonym. Haricot intestin.

** Seeds of uniform color (not white).

† Edible pods green.

No. 33. Long Yellow Six Weeks.— A vigorous, strictly dwarf bush bean, edible pods grayish green; beans slightly kidney form, rarely compressed on the ends, varying from yellowish brown when first shelled to light brown when older, a dark ring about the eye; full description First Report, 1882, p. 109, No. 39.

Synonyms. Six Weeks, Yellow Six Weeks, Haricot flageolet jaune, Haricot ronds printaniers, Goldbohne, Gelbe Eierbohne, etc., etc.

No. 34. Venezuelan No. 5.—This unnamed bean, received from U. S. Consul, Beach, would have been included with the preceding had it not been for its very bright yellow color. In all other respects the two are identical.

No. 35. Haricot Suisse ventre de biche.—A strictly dwarf bush bean. Beans of medium size, scarcely or not at all kidney form, usually compressed on one end, rarely on both, light dun color with veiny markings, a dark yellowish brown ring about the eye. In color very similar to No. 11, Newington Wonder, but easily distinguished from it in form.

No. 36. Dwarf Russian.—A moderately tall, strictly dwarf bush bean; beans scarcely kidney form, not compressed at the ends, light dun color, with a darker ring about the eye, and a peculiar rough feeling when handled; full description First Report, 1882, p. 110, No. 40.

No. 37. Ne Plus Ultra.—A moderately vigorous strictly dwarf bush bean, edible pods grayish green, beans scarcely or not at all kidney shape, rounded at the ends, bright yellowish brown with a darker ring about the eye.

No. 38. Kentucky Wonder.—A moderately tall growing pole bean, edible pods light green, very long, nearly cylindrical, beans of medium size, scarcely or not at all kidney form, dark brownish drab with veiny markings, a yellowish ring about the eye and a polished appearance; full description First Report, 1882, p. 110, No. 41.

No. 39. Early Dun Colored.—A moderately vigorous, strictly dwarf bush bean, beans usually slightly kidney form, frequently compressed on the ends, dark dun brown, with an almost black ring about the eye; full description First Report, 1882, p. 110, No. 42.

Synonym. Dark Dun, Krupbohne mit gruenen Schoten.

No. 40. Haricot Flageolet Noir.—A strictly dwarf bush bean, edible pods green; beans scarcely or not at all kidney form, rarely compressed on the ends, jet black, shining.

Synonyms. Haricot noir hatif de Belgique, Schwarze Negerbohne.

†† Edible pods yellow.

No. 41. Golden Butter Wax.—A low, strictly dwarf bush bean, beans slightly kidney form, rarely compressed at the ends, jet black, shining; full description First Report, 1882, p. 103, No. 21.

Synonyms. Haricot d'Alger noir nain, Haricot d'Alger noir nain a longue cosse.

*** Seeds variegated.

No. 42. Red Valentine.—A rather vigorous, strictly dwarf bush bean, edible pods usually strongly recurved, grayish green, beans of medium size, not kidney form, rarely compressed at the ends, often irregularly bent and indented, light brown or dun color, splashed and striped with dull reddish pink, a yellowish brown ring about the eye.

No. 43. Fullmer's Early.—A bush bean sending out short barren runners, edible pods green, beans rather large, slightly or not at all kidney shape, usually very slightly flattened sidewise, not compressed on the ends, light brown or dun color, nearly entirely covered with dark red, the two colors sharply separated, a yellowish brown ring about the eye.

Synonym. Haricot Suisse sang de boeuf.

No. 44. Early Mohawk.—A strictly dwarf bush bean, edible pods green, beans slightly or not at all kidney form, occasionally slightly

compressed at the ends, light brown or dun colored, almost entirely covered with dark purplish brown, a reddish brown ring about the eye; full description First Report, 1882, p. 107, No. 34.

Synonyms. Purple Speckled, Early Brown Six Weeks, Purpurschec-kige Dattelbohne, Ganz Fruehe Ilsenburger Bohne, etc., etc.

No. 45. Refugee. — A very vigorous, strictly dwarf bush bean, usually prostrate, edible pods pearly green, usually marked with purple; beans of medium size; very slightly kidney form, rarely compressed on the ends, light brown or dun color, striped and splashed with dark reddish purple; full description First Report, 1882, p. 111, No. 44.

Synonyms. One Thousand to One, Brown Speckled Valentine, Tuerkische Dattelbohne, Haricot lilas vert, etc., etc.

No. 46. Galega.— Only distinguished from the last by the slightly larger size and different color of the ripe beans; beans light brown or dun colored splashed and streaked with purplish black; full description First Report, 1882, p. 111, No. 45.

Synonym. Large Refugee.

No. 47. Black Speckled.— A very vigorous, upright strictly dwarf bush bean, edible pods whitish green often marked with dark purple; beans rather large, slightly kidney shape, usually slightly flattened sidewise, rarely compressed on the ends, light brown or dun colored, nearly entirely covered with jet black splashings.

III. Seeds oblong, never more than twice as long as broad, often nearly spherical.

(*a.*) Seeds distinctly oblong, usually with rounded ends.

* Edible pods green.

† Seeds of uniform color.

No. 48. Navy or Pea, universally grown as a bush bean, but with a distinct twining habit; beans small, not kidney form nor compressed at the ends, white, with an indistinct veiny net work; full description First Report, 1882, p. 104, No. 25.

Synonyms. Mexican Tree, Mexican or California Prolific Tree, California Branch, Haricot Comtesse de Chambord.

No. 49. White Medium. — A bush bean with a distinct twining habit, beans rather small, larger than No. 48, but otherwise not to be distinguished from it.

Synonym. Haricot rond blanc commun.—The bean received from U. S. Consul Beach as Venezuelan No. 6, proved to be of this variety.

No. 50. White Marrow.—A bush bean of rather slender habit, and a distinct tendency to twining, beans medium or rather large, regularly oval, with a distinct tendency to split open on the back while ripening, white with a veiny net work, smooth but not polished; full description, First Report, 1882, p. 105, No. 26.

Synonyms. White Marrowfat, Dwarf White Cranberry, White Egg, Large White Marrow, Mountain, Marrow, White Corn Hill.

No. 51. Round White Princess.—A bush bean with a distinct twining habit; beans oval, approaching very nearly to globular, white with an indistinct veiny net work, polished; full description, First Report, 1882, p. 104, No. 24.

Synonyms. True White Pea, Haricot Princesse, Stangen-Perlbohne, Krup Perl Bohne.

No. 52. Holsteiner Bohne.—Only distinguished from the last by being strictly dwarf.

No. 53. Haricot Saumon du Mexique.—A strictly dwarf bush bean; beans regularly oval, very slightly flattened sidewise, not compressed on the ends, eye plane, pale brown or dun color, with veiny markings, a dark yellowish brown ring about the eye.

No. 54. Intermediate Dun Cranberry.—A vigorous strictly dwarf bush bean; beans of medium size, regularly oval, rarely compressed on the ends, eye plane or slightly protuberant, pale dun inclining to yellow, with a veiny net-work, a dark brown ring about the eye; full description, First Report, 1882, p. 99, No. 9.

No. 55. Haricot rouge d'Orleans.—A strictly dwarf bush bean; beans oval or almost oblong, very slightly flattened sidewise, not compressed on the ends, eye plane or slightly protuberant, light red varying to reddish brown, a darker, almost black ring about the eye.

No. 56. Hundred for One.—A moderately vigorous, strictly dwarf bush bean; beans rather small, oblong, about twice as long as broad, not kidney form, often compressed on the ends; bright yellowish brown, with a veiny net-work.

No. 57. Round Yellow Six Weeks.—A moderately vigorous, strictly dwarf bush bean; beans regular, oval not kidney-form, rarely slightly compressed at the ends; bright yellowish brown with an indistinct veiny net-work, a darker ring about the eye.

No. 58. Southern Prolific.—A tall growing pole bean; beans of medium size, oblong, not kidney-form nor compressed at the ends, dark dun brown with veiny markings, an indistinct reddish brown ring about the eye.

No. 59. Black Negro.—A moderately vigorous, strictly dwarf bush bean; beans of medium size, oblong, not kidney-form nor compressed at the ends, jet black, shining.

†† Seeds variegated.

No. 60. Early China.—A vigorous, strictly dwarf bush bean; beans oblong, very slightly flattened sidewise, not kidney-form or compressed on the ends, white with a large spot about the eye, dark red mottled with light brown or dun color; full description, First Report, 1882, p. 103, No. 23.

Synonyms. China, Red Eyed China, Red Eye, China Red Eye, Early China Red Eye, Haricot Chinois, Chinesische Dattelbohne, Adlerbohne.

No. 61. Yellow Eyed China.—A vigorous bush bean with a distinct twining habit; beans oblong scarcely or not at all kidney-form, not compressed on the ends, white, with the half about the eye yellowish brown, except for the coloring, resembling very closely White Marrow; full description, First Report, 1882, p. 105. No. 28.

No. 62. Early Rachel.—A moderately vigorous, strictly dwarf bush bean; beans of medium size, oblong, slightly kidney-form, not compressed on the side, dark brown with an irregular white spot of greater or less size on one end. In every case noticed the white end of the bean was turned toward the point of the pod; full description, First report, 1882, p. 107, No. 33.

Synonym. Quail Head.

No. 63. French Emile.—A low, vigorous, strictly dwarf bush bean; beans of medium size, oblong, not kidney-form or compressed at the

ends, dark chocolate purple mottled with light brown, an indistinct yellowish brown ring about the eye; full description, First Report, 1882, p. 108, Ko. 35.

Synonym. Haricot Emile nain sans parchemin.

No. 64. Osborn's Forcing.—A moderately vigorous, strictly dwarf bush bean; beans of medium size, oblong, not compressed on the ends, eye plane, dark brown mottled with light brown or dun, an indistinct yellowish brown ring about the eye.

Synonym. Osborn's Early Forcing.

** Edible pods yellow or yellowish white.

No. 65. White Wax.—A low, vigorous, strictly dwarf bush bean, beans rather small, irregularly globular or slightly oblong, with a peculiar shrunken appearance, eye plane or slightly protuberant, pure white; full description, First Report, 1882. p. 101, No. 14.

Synonyms. White Round Wax, White German Wax, Dwarf German Wax, White; Haricot beurre blanc nain, Krup Wachsbohne mit gelben Schoten.

No. 66. Ivory Pod Wax.—A rather vigorous bush bean, sending out slender barren runners, edible pods very nearly pure white, beans of medium size, oblong, slightly flattened sidewise, rarely slightly kidney-form, not compressed at the ends, pure white; full description, First Report, 1882, p. 101, No. 15.

No. 67. Lemon Pod Wax.—Almost identical with the preceding but with edible pods yellow.

No. 68. Crystal Wax.—A vigorous bush bean, sending out short runners, edible pods a peculiar translucent pale pearly green, beans rather small, oblong, slightly flattened sidewise, slightly kidney-form, pure white; full description, First Report, 1882, p. 101, No. 16.

No. 69. White Algerian Wax.—A slender pole bean of medium height, beans rather small, oblong, slightly kidney-form, usually slightly compressed on the ends, pure white with an indistinct veiny net-work, polished; full description, First Report, 1882, p. 101, No. 17.

No. 70. Yellow Podded Princess.—A strictly dwarf bush bean, edible pods yellow or yellowish green, beans medium or rather small, regularly oval, occasionally compressed on the ends, eye plane, pure dead white, lustreless. Chiefly distinguished from No. 65 by the smooth rounded form and lustreless white of the bean.

No. 71. Boston Dwarf Wax.—A moderately vigorous, strictly dwarf bush bean; beans small, oblong, slightly flattened sidewise, rarely compressed at the ends, eye plane, varying from dark dun to dark brown, with a black ring about the eye; full description, First Report, 1882, p. 107, No. 32.

No. 72. Mont D'Or.—Usually grown as a pole bean, although scarcely climbing, about three to four feet high, beans of medium size, oval, very slightly flattened sidewise, eye plane or often slightly protuberant, dark brown indistinctly mottled with dull purple; full description, First Report, 1882, p. 102, No. 18.

Synonyms. Golden Butter, Butter or Wax, Stangen-Wachsbohne mit gelben Schoten.

No. 73. Dwarf Black Wax.—A moderately vigorous strictly dwarf bush bean; beans of medium size, oblong, scarcely or not at all kidney-form; not flattened sidewise or compressed on the ends, jet black, shining; full description, First Report, 1882, p. 102, No. 20.

Synonyms. Black Wax, Butter.

No. 74. Dwarf Mont D'Or.—Only distinguished from the preceeding by its shorter proportionate length, and by the purple flecks on the fully developed pods; full description, First Report, 1882, p. 102, No. 19.

No. 75. Dwarf Golden Wax.—A strictly dwarf bush bean, not vigorous, beans of medium size, oblong, not compressed on the ends, eye plane, the half about the eye mottled with dull purple, the rest white. The amount of white on the bean is very variable; often there is scarcely any; full description, First Report, 1882, p. 103, No. 22.

Synonyms. York Dwarf Wax; D. M. Ferry & Co's. Golden Wax.

(b.) Seeds spherical or nearly so.

* Seeds of uniform color.

No. 76. Perl Reis Krupbohne.— A strictly dwarf bush bean from Germany, edible pods light green, beans very small, almost spherical, slightly longer than broad, dirty white.

No. 77. White Cranberry.—A slender, scarcely running pole bean, two and a half by three feet high, edible pods green; beans medium or rather large, nearly globular. very slightly flattened sidewise, eye plane or often slightly protuberant, fine ivory white, polished; full description, First Report, 1882, p. 99, No. 11.

Synonyms. Haricot blanc, Haricot Sophie, Die Sophienbohne, etc.

No. 78. Pale Dun Runner.—A vigorous, moderately tall pole bean, edible pods light green; beans medium or rather large, nearly globular, occasionally compressed at the ends, eye usually protuberant, light brown or dun with a bright yellow ring about the eye, polished; full description, First Report, 1882, p. 98, No. 8.

No. 79. Princess Rose.—A slender pole bean, two to three feet high, edible pods light green, beans small, nearly globular, very slightly longer than broad, occasionally slightly compressed on the ends, light reddish brown with a brown ring about the eye, polished.

No. 80. Golden Cranberry.—A moderately vigorous, strictly dwarf bush bean, edible pods green, beans of medium size, almost perfectly spherical, pale sulphur yellow with veiny markings, a faint pale bluish ring about the eye; full description, First Report, 1882, p. 99, No. 10.

Synonyms. Canadian, Round American Kidney, Golden Drop, Round Seeded Canary, Haricot de la Chine jaune; Schwefelgelbe Kugelbohne, Krup Prinzessinbohne, etc., etc.

No. 81. Red Cranberry.—A moderately vigorous pole bean, four to six feet high; edible pods green, beans of medium size, very nearly spherical, eye usually protuberant, deep dark red polished; full description, First Report, 1882, p. 98, No. 6.

Synonyms. Boston Market Pole Cranberry, Pearl without Strings, Cardinalsbohne, Cardinalsbohne ohne Fasern, etc., etc.

No. 82. Dwarf Red Cranberry.—A strictly bush variety of the preceding, otherwise distinguished from it by the slightly oblong shape of the beans; full description, First Report, 1882, p. 98, No. 7.

No 83. Indian Chief.—A slender climbing pole bean, three to four feet high; edible pods yellow, beans rather large, irregularly globose, often slightly oblong, sometimes with a shrunken appearance, eye usually protuberant; black inclining to purplish; full description, First Report, 1882, p. 97, No. 5.

Synonyms. Wax bean, Butter bean, Black Algerian, Black Wax, German Wax, Haricot d'Alger ou beurre noir, Haricot beurre du Mont D'Or, Schwarz Stangen Wachs-bohne, Stangen Wachs-bohne, Chinesische Butter-bohne, etc., etc.

** Seeds variegated.

No. 84. Horticultural.—A pole bean varying much in height, edible pods dark green; beans rather large, irregularly globose, usually slightly oblong, eye usually slightly protuberant, light brown or dun variously striped and spotted with dull dark red, the colors becoming darker with age; full description, First Report, 1882, p. 95, No. 1.

Synonyms. Marbled Prague, London Horticultural, Wren's Egg, Speckled Cranberry, Haricot de Prague Marbre.

No. 85. Intermediate Horticultural.—A strictly dwarf form of the preceding; otherwise distinguished from it by the more oblong form of the beans; full description, First Report, 1882, p. 96, No. 2.

Synonym. Dwarf Cranberry.

No. 86. Concord.—A slender pole bean three to four feet high, edible pods green, beans rather large, irregularly globose, more or less oblong, eye plane or slightly protuberant, the half about the eye light brown or dun, splashed with dull red, the remainder white with a veiny net-work and an occasional small spot of dun or red, a dark yellowish ring about the eye; full description, First Report, 1882, p. 96, No. 3.

No. 87. Mottled Cranberry.—A slender, not tall, pole bean, edible pods, green; beans rather large, irregularly globose, more or less long, sometimes compressed on the ends, eye plane or slightly protuberant, the half about the eye and extending over one end, deep dark red, the remainder white with an occasional red spot; full description First Report, 1882, p. 97, No. 4.

Synonym. Stringless.

No. 88. Schwarzbunte Bohne.—A not vigorous, strictly dwarf bush bean, edible pods yellowish green, somewhat translucent, beans of medium size, nearly spherical, occasionally compressed on the ends, eye usually protuberant, light brown or dun color, variously striped and splashed, often nearly entirely covered with purplish black.

II. PHASEOLUS MULTIFLORUS, LAM.—The Scarlet Runner.

No. 89. Scarlet Runner.—A tall-growing pole bean with luxuriant foliage; flowers scarlet; pods, when fully developed, dark green, rough, sabre form, when ripe, dark brown, almost cylindrical, parchment-like; beans large, oblong, very slightly kidney form, flattened sidewise, occasionally compressed on the ends, black mottled with dull lilac; full description First Report, 1882, p. 115, No. 56.

Synonyms. Carter's Champion Runner, Searle's Carter's Champion, Haricot d'Espagne rovge, Tuerkenbohne.

No. 90. Painted Lady.—In many respects similar to the preceding. Lower petals of the flower pinkish-white, the rest scarlet, beans dark brown, mottled with creamy white.

Synonym. York and Lancaster.

No. 91. White or Dutch Runner.—A form of the Scarlet Runner with white flowers and white beans; in all other respects entirely similar.

Synonyms. Giant White, Haricot d'Espagne blanc, Weisse Tuerkische Bohne.

III. PHASEOLUS LUNATUS, L. —The Lima Bean.

No. 92. Large White Lima. — A tall-growing pole bean, pods leathery, short, very broad, flat, not much distended by the beans, beans large, broad, flat, more or less kidney form, white, or greenish-white, with veins radiating from the eye.

Synonym. Haricot de Lima.

Bliss' Early, Dreer's Improved, New Challenger and Potato are said to be distinct varieties of the Large White Lima, but owing to unfavorable seasons we have been unable to mature them sufficiently to bring out their variety characteristics.

No. 93. Small White Lima.— A smaller, earlier and more prolific variety than the preceding.

Synonyms. Frost, West Indian, Carolina, Carolina Sewee, Sieva, Saba, Haricot de Sieva.

No. 94. Red Lima.— Entirely similar to No. 92, except that the seeds are deep, dark red.

No. 95. Speckled Lima.— Entirely similar to No. 92, except that the seeds are white, striped and speckled with deep, dark red..

IV. DOLICHOS SESQUIPEDALIS. The Asparagus Bean.

No. 96. French Yard Long. A tall pole bean, needing a warmer climate than the Northern United States for full development; leaflets halberd-shaped, long and narrow, taper-pointed, very slightly pubescent. Flowers very large, purplish yellow, pods very long, eighteen to twenty-four inches, borne in pairs, almost cylindrical, not swollen by the beans, when nearly ripe very leathery; beans very distant in the pod, small, oblong, kidney form, flattened sidewise, not compressed on the ends, dark brown with a black ring about the eye; First Report, 1882, p. 115, No. 58.

V. DOLICHOS (sinensis?) The Southern Cow Pea.

We have been unable to mature the different varieties sufficiently to characterize them.

VI. VIGNA (?) The Chinese Bean.

No. 97. Chinese.— In general appearance resembling dwarf varieties of the kidney bean, flowers yellow, pods small, cylindrical, straight, bean small, crowded in the pods, therefore strongly truncate at the ends, nearly cylindrical, not kindey shape, pale yellowish dun, hilum white elongated.

No. 98. Azuki (from Japan).— Entirely similar to the preceding, with the exception of the dark reddish brown color of the beans.

VII. SOJA HISPIDA, Moench.— The Soja Bean.

The study of the varieties of the Soja bean has not been entirely satisfactory because some of them were cut off by the frost before ripening. The following appear to be sufficiently distinct:

No. 99. Soja hispida d'Etampes.— Seeds nearly spherical, yellowish green, often with a brownish cast, flowers yellow and purple.

No. 100. Yellow Soja.— Seeds slightly elongated, creamy yellow, often with a greenish tinge, flowers white.

Synonym. Daizu (from Japan.)

No. 101. Red Soja.— Seeds nearly spherical, dark reddish brown, flowers white.

No. 102. Soja hispida a grain noir.—Seeds nearly spherical dull black, flowers purple and white.

RELATION OF VEGETATION TO GERMINATION.

An investigation under charge of, and reported by the Assistant Horticulturist.

In the early spring we could not but notice the variation that existed between the germinative properties of our seed as tested in our apparatus and the vegetative properties under circumstances of actual planting. We hence devised a series of trials for testing the relations, if any, between germination and vegetation — by germination meaning the vitality sufficient to form a radicle, and by vegetation the vitality required to form a plant. In our germinative apparatus, as described in another place as used for commercial seeds, the seeds were counted and removed as fast as the radicle appeared. In our vegetations, seeds from the same packages used for the duplicate germinative trials were planted in clean sand at one quarter to one-half inches depth according to the species, moisture supplied by capillary attraction from water furnished at the base of the apparatus, and the plants removed as the cotyledons had formed and growth had commenced. The following table gives in detail the data obtained for each species of vegetable in the vegetations and a column of germination of duplicates under trial. In the last column the percentage relation of the vegetations to the germinations offer figures for comparison.

TABLE giving in detail the data obtained for each species of vegetable in the vegetations and a column of germination of duplicates under trial.

VEGETABLE.	VARIETY.	Year of growth.	Date tested.	Age of seed, years.	No. of seed used.	First seed sprouted — days.	Half sprouted — days.	Last sprouted — days	Total days under trial.	Per cent germinated.	Per cent vegetated.	Percentage relation of vegetation to germination.
Bean	Dwarf Black Wax	1881	Oct. 18	2	25	9	10	11	50	100	96	96
	Dwarf Black Wax	1881	"	2	25	8	9	9	50	96	60	63
	Dwarf Black Wax	1881	"	2	25	8	8	9	50	96	100	104
	Dwarf Black Wax	1881	"	2	25	9	10	11	50	82	88	107
	French Yard Long	1881	"	2	25	8	10	13	50	100	56	56
	Best of All	1880	"	3	25	9	9	11	50	98	100	102
Brocoli	Early White	1882	"	1	50	7	9	16	50	55	40	73
	White Sprouting	1881	"	2	50	5	6	11	50	92	82	89
	Chapel's Cream	1881	"	2	50	7	9	16	50	60	36	60
	Purple	1880	"	3	50	9	12	15	50	61	24	39
	Sulphur Color	1880	"	3	50	8	11	16	50	57	36	63
	Purple Sprouting	1879	"	4	50	11	14	15	50	55	14	25
Brussels Sprouts	....	1882	"	1	50	8	10	14	50	70	58	83
	....	1881	"	2	50	6	6	14	50	91	78	86
	Improved Dwarf	1881	"	2	50	7	8	15	50	69	46	67
Cabbage	Little Pixie	1882	"	1	50	5	8	13	50	64	48	75
	Early Winnigstadt	1882	"	1	50	6	8	15	50	83	54	65
	Large Late Drumhead	1882	"	1	50	5	6	13	50	79	76	96
	Eleven Leaf Drumhead	1882	"	1	50	5	6	8	50	67	68	101
	Early Drumhead	1882	"	1	50	6	9	12	50	68	58	85
	Fine Large Flat Dutch	1882	"	1	50	5	6	11	50	90	70	78
	Fine Large Flat Dutch	1882	"	1	50	5	6	12	50	58	34	59
	Fine Large Flat Dutch	1882	"	1	50	6	7	10	50	87	70	80
	Fottler's Improved Brunswick	1882	"	1	50	5	6	10	50	98	86	88
	Red Pickling	1882	"	1	50	6	7	10	50	79	82	104
	St. John's Day Early Drumhead	1882	"	1	50	6	7	11	50	84	72	86

TABLE GIVING THE DATA, ETC. — (*Continued*).

VEGETABLE.	VARIETY.	Year of growth.	Date tested.	Age of seed.	No. of seed used.	First seed sprouted — days.	Half sprouted — days.	Last sprouted — days.	Total days under trial.	Per cent germinated.	Per cent vegetated.	Percentage relation of vegetation to germination.
Cabbage...	Flat Dutch	1882	Oct. 18	1	50	5	6	11	50	94	82	87
	Early Jersey Wakefield	1881	"	2	50	6	8	11	50	70	56	80
	Dwarf Savoy	1881	"	2	50	5	6	13	50	91	80	88
	Large Early York	1881	"	2	50	5	6	18	50	72	58	81
	Early First Dutch	1881	"	2	50	4	5	6	50	66	74	112
	Flat Dutch	1881	"	2	50	7	9	12	50	86	48	56
	Flat Dutch	1881	"	2	50	7	9	12	50	58	26	45
	Strasburg Drumhead	1881	"	2	50	7	7	12	50	64	62	97
	Strasburg Drumhead	1881	"	2	50	7	7	12	50	100	78	78
	Strasburg Drumhead	1881	"	2	50	7	8	12	50	66	46	70
	Fine Large Flat Dutch	1881	"	2	50	6	7	11	50	41	44	107
	Late Drumhead Savoy	1881	"	2	50	6	6	10	50	86	74	86
	Late Drumhead Savoy	1881	"	2	50	5	6	11	50	88	84	95
	Late Drumhead Savoy	1881	"	2	50	6	6	10	50	90	94	104
	Stone Mason Marblehead	1881	"	2	50	7	7	12	50	52	48	92
	Sugar Loaf	1881	"	2	50	6	8	12	50	84	52	153
	Sugar Loaf	1881	"	2	50	6	8	12	50	78	60	77
	Early Drumhead	1881	"	2	50	6	8	18	50	70	58	83
	Early Winnigstadt	1881	"	2	50	6	7	13	50	98	96	98
	Early Winnigstadt	1881	"	2	50	6	7	16	50	92	80	87
	Early Winnigstadt	1881	"	2	50	6	7	12	50	86	74	86
	Early Winnigstadt	1881	"	2	50	7	8	18	50	56	52	93
	Early Winnigstadt	1881	"	2	50	6	6	14	50	84	76	90
	Early Winnigstadt	1881	"	2	50	6	7	16	50	78	84	108
	Early Winnigstadt	1881	"	2	50	6	7	13	50	74	70	94
	Winnigstadt	1881	"	2	50	6	7	12	50	82	80	98
	Early Rainham	1880	"	3	50	6	7	11	50	66	44	67
	Early Oxheart	1880	"	3	50	8	9	15	50	59	34	58
	Late Drumhead Savoy	1878	Oct. 22	5	50	11	12	16	50	83	38	115
	Little Pixie	1877	"	6	50	...	....	..	50	.....	......	.....
	Early Dutch	1877	"	6	50	...	....	....	50	4	.....	.....
	Early Flat Dutch	1877	"	6	50	7	8	10	50	30	61	20
	Late Drumhead Savoy	1877	"	6	50	12	15	19	50	27	22	81
	Late Drumhead Savoy	1877	"	6	50	11	13	17	50	59	46	78

	Early Dwarf Savoy	1876	"	7	50	7	11	15	50	32	16	50
	Large Early York	1875	"	8	50	....	....	....	50	.....	.....	.....
	Early Ulm Savoy	1873	"	10	50	....	....	....	50	.....	.....	.....
	Fine Large Flat Dutch	1873	"	10	50	....	....	....	50	.....	.....	.....
	St. John's Day Early Drumhead	1873	"	10	50	....	....	....	50	.....	.....	.....
	Fine Large Flat Dutch	1867	"	16	50	....	....	....	50	.....	.....	.....
	Large Early York	1867	"	16	50	....	....	....	50	.....	.....	.....
	Early Oxheart	1866	"	17	50	....	....	....	50	.....	.....	.....
	Early Oxheart	1872	"	11	50	....	....	....	50	.....	.....	.....
Cardoon	Large Solid	1882	"	1	50	12	13	18	50	74	64	87
Carrot	Extra Early Forcing	1882	"	1	50	16	16	18	50	41	28	68
	Early Horn	1882	"	1	50	11	13	17	50	60	48	80
	Half Long Red Pointed	1882	"	1	50	11	11	15	50	68	40	59
	Half Long Stump-rooted	1882	"	1	50	11	13	16	50	56	50	89
	Half Long Stump-rooted	1882	"	1	50	14	15	17	50	27	15	56
	Half Long Cauntan	1882	"	1	50	10	13	17	50	75	42	56
	Half Long Luc	1882	"	1	50	11	14	18	50	61	28	46
	Danvers	1882	"	1	50	14	16	17	50	31	21	68
	Danvers	1882	"	1	50	14	15	17	50	83	31	37
	Altringham	1882	"	1	50	17	17	17	50	2	2	100
	Long White	1882	"	1	50	14	18	21	50	84	30	36
	Early Horn	1881	"	2	50	13	14	15	50	37	18	46
	Half Long Stump-rooted	1881	"	2	50	12	14	15	50	70	28	40
	Half Long Cauntan	1881	"	2	50	14	15	21	50	26	17	65
	Long White	1881	"	2	50	14	15	19	50	68	29	43
	Long Orange	1880	"	3	50	15	17	20	50	29	19	66
	Extra Early Forcing	1877	"	6	50	....	....	....	50	.....	.....	.....
Cauliflower	Early Paris	1882	Oct. 27	1	50	5	5	12	50	95	86	91
	Imperial	1882	"	1	50	8	12	19	50	50	22	44
	Large Algiers	1882	"	1	50	5	6	11	50	89	34	38
	Large Early London	1882	"	1	50	6	5	18	50	81	60	74
	Thorburn's Nonpareil	1882	"	1	50	6	7	10	50	88	88	100
	Early Walcheren	1882	"	1	50	6	7	16	50	85	78	92
	Le Normand's Short Stem	1882	"	1	50	6	7	11	50	80	44	55
	Le Normand's Short Stem	1881	"	2	50	6	7	10	50	68	52	76
	Autumn Giant	1881	"	2	50	6	7	13	50	85	72	85
	Thorburn's Wonderful	1880	"	3	50	7	9	14	50	51	36	71
	Thorburn's Nonpareil	1880	"	3	50	7	8	13	50	97	92	95
Chervil	.....	1881	"	2	50	10	10	15	50	44	27	61
	.....	1866	"	17	50	11	11	11	50	.....	1	.....
Catnip	.....	1875	Oct. 30	8	50	....	....	....	50	.....	.....	.....
Dyer's Madder	.....	1881	"	2	50	....	....	....	50	.....	.....	.....
Jute	.....	1881	"	2	50	17	17	17	50	47	2	4
Kale	Green Curled Scotch	1881	Nov. 9	2	50	6	6	10	50	97	92	95
	Green Curled Scotch	1881	"	2	50	6	7	10	50	89	70	79
	Green Curled Scotch	1880	"	3	50	9	11	16	50	33	8	24
	Garnishing	1877	"	6	50	6	9	12	50	65	60	92
	Garnishing	1877	"	6	50	7	9	12	50	63	56	89
Kohl Rabi	Purple Vienna	1882	"	1	50	6	6	18	50	83	66	79
	Purple Vienna	1882	"	1	50	6	6	12	50	81	76	94

TABLE GIVING THE DATA, ETC. — (*Continued*).

VEGETABLE.	VARIETY.	Year of growth.	Date tested.	Age of seed, years.	No. of seed used.	First seed sprouted — days.	Half sprouted — days.	Last sprouted — days.	Total days under trial.	Per cent germinated.	Per cent vegetated.	Percentage relation of vegetation to germination.
Kohl Rabi	Grand Purple	1879	Nov. 9	4	50	7	11	19	50	70	58	83
	White Giant	1879	"	4	50	7	13	19	50	19	30	160
Lettuce	Early Curled Simpson	1881	Oct. 27	2	50	5	7	15	50	78	80	103
	Shotwell's Brown Head	1881	"	2	50	5	6	13	50	62	76	123
	New Orleans Green Cabbage	1881	"	2	50	4	5	6	50	97	94	97
	Large Yellow Butter	1881	"	2	50	4	4	16	50	62	74	119
	Gray Seeded Butter	1881	"	2	50	5	5	8	50	78	86	111
	White Cos	1881	"	2	50	4	5	11	50	97	78	80
	Green Cos	1881	"	2	50	4	5	6	50	94	82	87
	Red Winter Cabbage	1881	"	2	50	6	11	13	50	37	22	59
	Black Seeded	1880	"	3	50	5	5	11	50	96	84	88
	American Gathering	1880	"	3	50	5	6	10	50	89	92	103
	Early Tennis Ball	1880	"	3	50	5	6	13	50	91	98	108
	Early Tennis Ball	1880	"	3	50	6	7	14	50	95	58	61
	Hanson	1880	"	3	50	5	6	14	50	87	74	85
	Victoria Cottage	1880	"	3	50	5	6	13	50	94	96	102
	India Head	1880	"	3	50	4	5	13	50	88	80	91
	Ice Drumhead	1880	"	3	50	6	10	17	50	55	36	65
	Early Tennis Ball	1874	"	9	50	...	....	....	50	......	......	....
Melon, Water	Sculptured Seeded Japan	1881	Oct. 22	2	50	...	....	....	50	......	......	....
	Early Mountain Sprout	1881	"	2	50	10	12	16	50	86	88	102
	Goodwin's Imperial	1881	"	2	50	8	14	21	50	67	74	111
	Apple Seeded	1875	"	8	50	...	....	....	50	2	......	....
Melon, Musk	New Surprise	1881	"	2	50	11	12	15	50	97	82	85
	Sill's Hybrid	1881	"	2	50	8	12	20	50	90	96	107
	Allen's Superb	1880	"	3	50	11	12	16	50	95	84	88
	Long Yellow Cantaloupe	1877	"	6	50	10	12	21	50	87	62	71
	Imp. Netted Cantaloupe	1877	"	6	50	8	14	22	50	92	68	74
Mustard	Black	1881	"	2	50	5	5	9	50	82	80	98
	White	1881	"	2	50	4	4	10	50	100	98	98
	White	1881	"	2	50	4	4	5	50	99	92	93
	White	1881	"	2	50	4	4	8	50	99	88	99
	White	1880	"	3	50	4	5	12	50	70	64	91
	White	1880	"	3	50	4	4	11	50	96	80	83
	Chinese	1880	"	3	50	4	5	10	50	77	76	90

	Chinese	1873	"	10	50	8	8	10	50	8	4	50
Nasturtium	Tall	1877	"	6	50	....	...	..	50	4	.....	......
Onion	Silver Skin	1882	Nov. 5	1	50	18	18	26	50	11	4	36
	The Queen	1882	"	1	50	10	11	15	50	57	26	46
	White Portugal	1882	"	1	50	10	11	16	50	90	86	96
	White Portugal	1882	"	1	50	9	11	14	50	78	62	80
	White Portugal	1882	"	1	50	9	9	17	50	91	80	88
	White Portugal	1882	"	1	50	9	10	14	50	98	90	92
	White Globe	1882	"	1	50	9	9	12	50	96	90	94
	White Globe	1882	"	1	50	9	11	15	50	50	44	88
	White Globe	1882	"	1	50	9	9	15	50	90	88	98
	Early Red Flat	1882	"	1	50	9	10	16	50	71	54	76
	Large Red Globe	1882	"	1	50	9	10	16	50	71	56	79
	Large Red Globe	1882	"	1	50	9	10	16	50	93	74	80
	Large Red Globe	1883	"	1	50	9	10	15	50	87	70	80
	Large Red Globe	1882	"	1	50	9	9	15	50	98	92	94
	Large Red	1882	"	1	50	11	12	16	50	86	48	56
	Large Red	1882	"	1	50	9	11	15	50	71	72	101
	Large Red	1882	"	1	50	9	10	15	50	93	92	99
	Yellow Globe Danvers	1882	"	1	50	9	10	17	50	96	50	52
	Yellow Danvers	1882	"	1	50	9	10	16	50	84	68	81
	Yellow Danvers	1882	"	1	50	9	10	16	50	94	78	83
	Yellow Danvers	1882	"	1	50	9	10	16	50	84	62	74
	Welsh for Salad	1882	"	1	50	12	14	18	50	30	32	107
	Yellow Globe	1882	"	1	50	9	10	16	50	97	84	87
	Brown Teneriffe	1882	"	1	50	12	14	20	50	15	20	133
	Globe Madeira	1881	"	2	50	12	12	20	50	67	74	111
	Flat Madeira	1881	Oct. 27	2	50	13	13	20	50	74	56	76
	White Globe	1881	"	2	50	10	11	2	50	77	82	106
	Yellow Dutch	1881	"	2	50	....	..	....	...	30	.....	......
	Yellow Dutch	1880	"	3	50	12	12	12	50	69	32	46
Parsley		1882	"	1	50	13	14	22	50	92	84	91
		1882	"	1	50	12	13	18	50	60	64	107
		1881	"	2	50	13	14	22	50	86	64	74
Parsnip		1882	"	1	50	14	15	21	50	75	72	96
		1882	"	1	50	16	18	26	50	3	14	467
Pepper		1882	"	1	50	8	11	14	50	72	56	78
		1881	"	2	50	8	10	13	50	73	12	99
		1875	"	8	50	...	....	..	50	.....	...	......
		1874	"	9	50	....	....	..	50	3	.....	.....
Radish	French Breakfast	1882	"	1	50	5	7	17	50	68	46	68
	Early Frame	1882	"	1	50	5	6	12	50	92	80	87
	Early Scarlet Turnip	1882	"	1	50	5	6	10	50	88	72	82
	Scarlet Turnip	1882	"	1	50	4	5	10	50	44	36	82
	Scarlet Turnip	1882	"	1	50	5	5	12	50	42	44	105
	Scarlet Turnip	1882	"	1	50	4	5	12	50	[illegible]	74	82
	Scarlet Turnip	1882	"	1	50	5	6	12	50	74	64	86
	Scarlet Turnip	1882	"	1	50	4	5	11	50	50	40	80
	Early White Turnip	1882	"	1	50	5	7	13	50	62	58	94
	White Turnip	1882	"	1	50	5	6	12	50	62	50	81

TABLE GIVING THE DATA, ETC.—(*Continued.*)

VEGETABLE.	VARIETY.	Year of growth.	Date tested.	Age of seed, years.	No. of seed used.	First seed sprouted —days.	Half sprouted — days.	Last sprouted — days.	Total days under trial.	Per cent germinated.	Per cent vegetated.	Percentage relation of vegetation to germination.
Radish	White Turnip	1882	Oct. 27	1	50	4	6	12	50	80	78	97
	White Turnip	1882	"	1	50	5	6	12	50	74	64	87
	Olive White	1882	"	1	50	5	7	14	50	64	94	147
	White Six Weeks	1882	"	1	50	5	5	12	50	72	56	78
	Long Scarlet Short Top	1882	"	1	50	5	6	10	50	68	42	62
	Long Scarlet Short Top	1882	"	1	50	5	6	9	50	68	56	82
	Olive Rose	1882	"	1	50	4	5	12	50	80	48	60
	Chinese Winter	1882	"	1	50	5	6	11	50	66	54	82
	Olive Scarlet	1882	"	1	50	5	6	12	50	72	42	58
	White Russian	1882	"	1	50	5	7	10	50	50	52	104
	Hay Long Scarlet	1882	"	1	50	5	5	9	50	49	54	110
	White Olive Shaped	1882	"	1	50	5	6	19	50	40	26	65
	White Summer Turnip	1882	"	1	50	6	6	8	50	78	42	54
	White Strasburg	1882	"	1	50	6	7	8	50	71	68	96
	Yellow Summer Turnip	1882	"	1	50	6	6	8	50	98	90	92
	Gray Summer Turnip	1882	"	1	50	6	6	8	50	76	26	34
	Black Spanish	1882	"	1	50	6	6	8	50	79	36	46
	White Spanisa	1882	"	1	50	6	6	8	50	98	86	88
	White Spanish	1882	"	1	50	6	7	8	50	89	38	43
	California Long White Winter	1882	"	1	50	6	6	7	50	82	64	78
	French Breakfast	1881	"	2	50	10	10	12	50	36	36	100
	Long White Naples	1881	"	2	50	4	5	10	50	62	60	97
	Long Scarlet Short Top	1881	"	2	50	...	...	...	50	42	...	...
	Long Scarlet Short Top	1881	"	2	50	5	6	9	50	54	30	56
	Olive White	1881	"	2	50	5	7	11	50	50	42	85
	White Spanish	1881	"	2	50	5	6	10	50	88	40	45
	French Breakfast	1881	"	2	50	5	7	12	50	56	28	50
	Farly Yellow Turnip	1881	"	2	50	5	6	12	50	88	74	84
	Gray Summer Turnip	1881	"	2	50	6	7	14	50	70	54	77
	Scarlet Chinese Winter	1880	"	3	50	6	6	8	50	87	56	64
	Golden Globe	1880	"	3	50	4	5	12	50	60	62	103
	White Russian	1880	"	3	50	5	6	14	50	64	28	44
	Olive White	1880	"	3	50	4	5	17	50	68	50	73
	Long Scarlet Purple Top	1879	"	4	50	5	7	12	50	64	38	59
	Black Spanish Round	1879	"	4	50	7	10	15	50	60	26	43

[illegible]	Early Scarlet Turnip	1878	"	5	50	8	8	8	50	20	4	20
	Early Scarlet Turnip	1876	"	7	50	9	9	9	50	3	2	66
Salsify	....	1881	"	2	50	10	11	20	50	63	46	73
Scorzonua	....	1881	"	2	50	10	10	20	50	16	16	100
Sorrel	....	1870	"	13	50	....	....	....	50	....	....	....
Squash	Early Green Shaped Bush	1881	"	2	50	11	11	21	50	100	42	42
	Ohio	1881	"	2	50	10	12	16	50	86	36	42
	Turban	1881	"	2	50	13	13	13	50	40	22	5
	Mammoth Chili	1881	"	2	50	12	12	14	50	86	12	14
	Perfect Gem	1880	"	3	50	15	15	15	50	72	2	3
	Little Cocoanut	1880	"	3	50	12	14	18	50	82	24	29
	Canada Crookneck	1880	"	3	50	13	15	17	50	52	14	27
	Boston Marrow	1869	"	14	50	....	....	....	50	....	....	....
Sorghum	Stewart's Hybrid	1882	Oct. 29	1	50	9	10	19	50	53	54	102
	Honduras	1882	"	1	50	10	10	15	50	57	52	91
	Early Orange	1882	"	1	50	9	12	19	50	25	20	80
	Red Empire	1882	"	1	50	10	13	15	50	38	30	79
	White Seeded	1880	"	3	50	10	11	20	50	79	48	61
	Amber Cane	1880	"	3	50	10	11	20	50	81	46	57
Sweet Basil	....	1881	Oct. 30	2	50	12	12	15	50	22	14	64
	....	1875	"	8	50	....	....	....	50	15	....	....
Tomato	Hathaway's Excelsior	1881	Oct. 29	2	50	10	11	23	50	72	60	83
	Green Gage	1881	"	2	50	10	11	23	50	90	94	104
	Pear Shaped	1881	"	2	50	10	11	23	50	91	100	110
	New Cocoanut	1881	"	2	50	10	11	23	50	93	90	97
	New French Upright	1881	"	2	50	10	11	23	50	78	58	74
	Turk's Turban	1880	"	3	50	9	10	21	50	98	78	80
	Red Valencia Auster	1880	"	3	50	10	12	25	50	72	80	111
	Broad Leaved Dwarf	1880	"	3	50	10	11	27	50	90	62	69
	Blount's Champion Cluster	1880	"	3	50	10	13	41	50	93	49	53
	Lyman's Mammoth Cluster	1880	"	3	50	10	11	23	50	93	98	105
	Acme	1879	"	4	50	10	11	22	50	65	52	80
	Blount's Champion Cluster	1879	"	4	50	11	13	23	50	89	92	103
	Trophy	1878	"	5	50	10	11	24	50	75	60	80
	Large Yellow	1877	"	6	50	12	12	16	50	99	94	95
	Golden Trophy	1877	"	6	50	9	11	21	50	93	96	103
	Large Yellow	1876	"	7	50	11	12	17	50	82	98	120
	Golden Trophy	1876	"	7	50	11	13	14	50	68	24	35
	New White Apple	1876	"	7	50	11	13	24	50	84	78	93
	Large Yellow	1875	"	8	50	12	13	27	50	83	86	104
	Red Valencia Cluster	1874	"	9	50	12	15	42	50	87	82	94
	Red Valencia Cluster	1873	"	10	50	14	19	25	50	78	56	72
	Yellow Cherry	1872	"	11	50	14	18	25	50	95	78	82
	Yellow Cherry	1870	"	13	50	18	21	27	50	87	64	74
Turnip	Cow Horn	1881	"	2	50	5	5	6	50	99	96	97
	Cow Horn Shapleaf	1881	"	2	50	5	5	6	50	98	96	98
	Long White Shapleaf	1880	"	3	50	5	5	10	50	97	88	91
	German Tilton	1880	"	3	50	5	5	8	50	99	92	93
	Pomeranean White Globe	1880	"	3	50	5	6	11	50	99	66	67
	Yellow Aberdeen	1880	"	3	50	5	6	16	50	88	62	70

TABLE GIVING THE DATA, ETC.— *(Continued)*.

VEGETABLE.	VARIETY.	Year of growth.	Date tested.	Age of seed, years.	No. of seed used.	First seed sprouted — days.	Half sprouted — days.	Last sprouted — days.	Total days under trial.	Per cent germinated.	Per cent vegetated.	Percentage relation of vegetation to germination.
Turnip	Robson's Golden Ball	1880	Oct. 29	3	50	5	5	10	50	99	82	83
	Montignany	1880	"	3	50	5	5	9	50	99	82	83
	Montignany	1879	"	4	50	10	10	17	50	54	4	7
	Black Storm	1878	"	5	50	6	7	17	50	99	98	99
	Pommanean White Globe	1878	"	5	50	7	8	14	50	91	46	51
	Green Globe	1878	"	5	50	6	8	16	50	95	54	57
	Long White Tankard	1878	"	5	50	6	8	13	50	90	70	78
	German Tilton	1877	"	6	50	8	11	16	50	77	14	18
	Green Barrel	1877	"	6	50	6	8	12	50	82	30	37
	Yellow Malta	1877	"	6	50	6	11	18	50	38	16	42
	New Yellow Finland	1876	"	7	50	7	8	16	50	89	60	67
	Guy Stone	1873	"	11	50	11	11	11	50	58	4	7
Turnip, Swede	Hardy Purple Top	1881	"	5	50	5	6	13	50	84	68	80
	Hardy Purple Top	1881	"	2	50	5	6	10	50	86	68	79
	Yellow Purple Top Bangholm	1881	"	2	50	5	6	7	50	100	90	90
	Yellow Purple Top Bangholm	1881	"	2	50	5	6	12	50	100	96	96
	Yellow Purple Top Skuvings	1881	"	2	50	5	5	12	50	100	98	98
	Yellow Purple Top Skuvings	1881	"	2	50	5	5	11	50	100	80	80
	Improved Yellow	1881	"	2	50	5	6	9	50	98	90	92
	Sutton's Champion	1880	"	3	50	5	10	18	50	61	46	75
	Laing's	1879	"	4	50	8	11	17	50	69	56	81
	Curly Top	1879	"	4	50	7	11	18	50	77	76	99
	Cobson's West Norfolk	1878	"	5	50	10	14	20	50	42	50	119
	Carter's Imperial	1878	"	5	50	10	14	20	50	44	36	82
	Warte's Eclipse	1878	"	5	50	7	10	18	50	82	24	29
	Cobson's West Norfolk	1874	"	9	50	14	14	14	50	......	2	......
	Bronze Top	1872	"	11	50	...	...	...	50	......	......	......
Tobacco	Pennsylvania	1881	"	2	50	....	....	....	50	12	10	85
	Ohio	1880	"	3	50	....	....	....	50	67	32	48
	Kentucky	1879	"	4	50	....	...	...	50	59	50	85
	Missouri	1879	"	4	50	....	....	....	50	26	22	85
	Connecticut Seed Leaf	1878	"	5	50	...	....	....	50	82	28	34
	Florida	1878	"	5	50	....	...	....	50	45	40	89
	Hungarian	1876	"	7	50	...	...	...	50	33	14	42
	Ohio	1876	"	7	50	...	...	....	50	39	10	26

	Turkish	1876	"	7	50	....	....	....	50	49	6	12
	Corn Seed Leaf	1863	"	10	50	...	....	....	50	.....	.....	....
Thyme	...	1881	Oct. 30	2	50	....	.	....	50	25	.....	....
Cotton	Upland	1882	"	1	50	10	12	18	50	46	8	18
Oats	Molds Ennobled	1881	Oct. 3	2	50	6	6	6	50	98	100	102
Osage Orange	...	1880	Oct. 30	3	50	42	43	44	50	3	3	100
	...	1880	"	3	50	41	43	44	50	8	8	100
Rosemary	...	1877	"	6	50	....	...	....	50	......	......	....

In table II, we give the average figures for the various agricultural plants arranged by the presumed age of the seed. From this last table we can form table III, showing the general relations of the vegetation precentage relation.

TABLE II.

	No. of samples.	Age; years.	Day when first seed vegetated.	Day when half had vegetated.	Day when last vegetated.	Per cent germinated.	Per cent vegetated.	Per cent relation of vegetation to germination.
Bean	5	2	8	9	11	95	80	84
	1	3	9	9	11	98	100	102
Brocoli	1	1	7	9	16	55	40	73
	2	2	6	7	13	76	59	77
	2	3	8	11	15	59	30	50
	1	4	6	7	8	55	14	25
Brussels sprouts	1	1	8	10	14	70	58	83
	2	2	6	7	14	80	62	77
Cabbage	12	1	5	7	11	79	67	85
	25	2	6	7	13	70	66	94
	2	3	7	7	13	64	39	61
	1	5	11	12	16	83	88	115
	5	6	10	12	16	24	15	63
	1	7	7	11	15	32	16	50
	1	8	....	....	....	...	....	....
	3	10	....	....	...	...	...	....
	1	11	....	...	....	....	....	.....
	2	16	...	.. .	....	....	...	.....
	1	17	...	.. .	..	....	...	....
Cardoon	1	1	12	13	18	74	64	87
Cauliflower	7	1	6	7	14	81	59	73
	2	2	7	7	12	76	62	82
	2	3	6	8	14	74	64	87
Carrot	11	1	13	15	17	55	30	57
	4	2	13	15	18	50	23	46
	1	3	15	17	20	50	23	46
	1	6	....	...	....	...	...	.....
Chervil	1	2	10	10	15	44	27	61
	1	17	11	11	11	...	1	.....
Catnip	1	8	...	....	....	....	....	.....
Cotton	1	1	10	12	18	46	8	18
Dyer's Madder	1	2	. .	....	....	....	...	....
Jute	1	2	17	17	17	47	2	4
Kale	2	2	6	7	10	93	81	87
	1	3	9	11	16	93	81	87
	2	6	6	9	12	64	58	91
Kohl Rabi	2	1	6	6	15	82	71	87
	2	4	7	12	19	44	44	100
Lettuce	9	2	5	6	11	75	76	101
	8	3	5	6	13	87	77	89
	1	9	...	...	...	..	...	...
Melon, Water	3	2	9	13	19	76	81	106
	1	8	.. .	....	....	2	. .	.....
Melon, Musk	2	2	9	12	18	93	89	96
	1	3	12	12	16	95	84	88
	2	6	9	13	21	89	65	72
Mustard	4	2	8	8	16	95	92	97
	3	3	6	7	17	81	73	91
	1	10	8	8	10	50	8	4
Nasturtium	1	6	...	...	...	...	4	.....
Onion	23	1	10	11	17	76	63	83
	4	2	10	11	15	85	62	53
Oats	1	2	6	6	6	98	100	102
Osage Orange	2	3	41	43	44	5	5	100
Parsley	2	1	12	14	20	76	74	98
	1	2	13	14	22	86	64	74
Parsnip	2	1	15	16	24	39	43	110
Pepper	1	1	8	11	14	78	72	56
	1	2	8	10	13	73	72	99
	1	8	....	....	....	....	....	.....
	1	9	....	....	...	. .	8	.....

TABLE II. — (*Continued.*)

	No. of samples.	Age; years.	Day when first seed vegetated.	Day when half had vegetated.	Day when last vegetated.	Per cent germinated.	Per cent vegetated.	Per cent relation of vegetation to germination.
Radish	30	1	5	6	11	71	56	79
	9	2	6	7	11	61	40	66
	4	3	5	6	13	69	49	71
	2	4	6	8	14	62	32	52
	1	5	8	8	8	20	4	20
	1	7	9	9	9	3	2	66
Rosemary	1	6	....	....	...	..	...	....
Salsify	1	2	10	11	20	63	46	73
Scorzonua	1	2	10	10	20	16	16	100
Sorrel	1	13	...	....	...	...	....	....
Squash	4	2	11	12	16	78	23	30
	3	3	13	15	17	69	13	20
	1	14	....	...	....	..	....	....
Sweet Basil	1	2	12	12	15	22	14	64
	1	8	....	..	...	....	15	.....
Sorghum	4	1	9	12	17	43	39	91
	2	3	10	11	20	80	47	59
Thyme	1	2	....	....	....		25	.....
Tomato	5	2	10	12	23	85	80	94
	5	3	10	11	27	89	73	82
	2	4	10	12	22	77	72	93
	1	5	10	11	24	75	60	80
	2	6	10	12	19	96	95	99
	3	7	10	13	19	78	67	86
	1	8	12	13	27	83	86	104
	1	9	12	15	42	87	82	94
	1	10	14	19	25	78	56	72
	1	11	14	18	25	95	78	82
	1	13	18	21	27	87	64	74
Turnip	2	2	5	5	6	98	96	98
	6	3	5	6	13	98	78	80
	1	4	10	10	17	54	4	7
	4	5	6	8	15	94	67	71
	3	6	6	10	15	66	20	30
	1	7	7	8	16	66	20	30
	1	10	11	11	11	58	4	7
Turnip, Swede	7	2	5	6	11	95	84	88
	1	3	5	10	18	61	46	75
	2	4	7	11	18	73	66	90
	3	5	9	12	19	56	37	66
	1	9	14	14	14	...	2	.....
	1	11	....	.. .	....	...		.....
Tobacco	1	2	..	. ..	....	12	10	85
	1	3	....	...	..	67	32	48
	2	4	...	...	....	42	36	85
	2	5	....	....	....	63	34	54
	8	7	....	....	....	44	8	12

TABLE III.

Vegetation percentage relation to germination.

Under 10 per cent, 4 times.
Between 10 and 20 per cent, 2 times.
Between 20 and 30 per cent, 3 times.
Between 30 and 40 per cent, 3 times.
Between 40 and 50 per cent, 4 times.
Between 50 and 60 per cent, 7 times.
Between 60 and 70 per cent, 7 times.
Between 70 and 80 per cent, 13 times.
Between 80 and 90 per cent, 21 times.
Between 90 and 100 per cent, 14 times.
100 per cent, 3 times.
Over 100 per cent, 7 times.

We thus see that on general terms vegetation is less than germination. If we arrange according to age of seed we have Table IV,

TABLE IV.

	No. of vegetables.	Per cent relation of vegetation to germination.	Extremes.
Of the one year seed	15	73	18 to 110
Of the two year seed	26	80	4 to 106
Of the three year seed	17	73	20 to 102
Of the four year seed	7	65	7 to 100
Of the five year seed	6	68	20 to 115
Of the six year seed	5	71	30 to 99
Of the seven year seed	5	50	18 to 86
Of the eight to the thirteen year seed,	7	62	4 to 104

and this indicates, what we had not suspected, that the influence of age of seed upon this percentage relation is not well marked.

If in treating of vegetation in general we must conclude that there is no necessary percentage relation between vegetative and germinative properties of garden seeds, and that age of seed exerts but little influence, it may not follow that there is no relation in seeds of the same kind. We, therfere, select from our Table I examples of duplicates, varieties, and form a new table.

TABLE V.

		Years.	Duplicates.	Per cent relation vegetation to germination.	Average.
Bean. ...	Dwarf Black Wax	2	4	63 to 107	92
Cabbage..	Fine Large Flat Dutch	1	3	59 to 80	72
	Flat Dutch	2	2	45 to 56	50
	Strassburg Drumhead	2	3	70 to 97	82
	Late Drumhead Savoy	2	3	86 to 104	95
	Sugar Loaf	2	2	77 to 153	115
	Early Winning stadt	2	7	86 to 108	93
	Late Drumhead Savoy	6	2	78 to 81	79

TABLE V.—(*Continued.*)

		Years.	Duplicates.	Per cent relation vegitation to germination.	Average.
Carrot ...	Half Long Stump rooted..	1	2	56 to 89	72
	Danvers.................	1	2	37 to 68	52
Lettuce ..	Early Tennis Ball	3	2	61 to 108	84
Mustard..	White...................	2	3	93 to 99	97
	White...................	3	2	83 to 91	89
Onion....	White Portugal..........	1	4	80 to 96	89
	White Globe.............	1	3	88 to 98	93
	Large Red Globe.........	1	4	79 to 94	83
	Large Red...............	1	3	56 to 101	85
	Yellow Danvers..... ...	1	3	74 to 83	79
Radish...	Scarlet Turnip...........	1	5	80 to 105	87
	White Turnip............	1	3	81 to 97	88
	Long Scarlet Short Top...	1	2	62 to 82	72
	White Spanish...........	1	2	43 to 88	65
Rutabaga,	Yellow Purple Top Bangholm	2	2	90 to 96	93
	Skeeving's Yellow........	2	2	80 to 98	89

and this table but justifies our previous conclusions.

It must be conceded, however, that we do not as yet know the limits within which our figures shall vary as between numerous duplicates of the seed from the same grower, taken from the same package, and sprouted under like conditions. We have trial of seed from the same grower, and the samples from the same crop, germinated under identical conditions, or rather within the same apparatus, and the results are below.

TABLE VI.

Duplicate Onion Seed Germinations.

Variety.	No. of seed at each head.	No. of duplicates.	Age. Years.	Average germination. Per cent.	Extreme germinations. Per cent.
Danvers Yellow......	50	20	1	87	70 to 96
Danvers Yellow......	50	15	1	87	74 to 94
Danvers Yellow......	50	16	1	91	82 to 98
Danvers Yellow......	100	8	2	71	50 to 82
Early Red...........	100	6	1	95	90 to 98
Giant Rocca.........	100	4	2	85	82 to 88
Red Bassano..	100	4	2	53	51 to 58
White Portugal	100	6	2	57	52 to 62
Yellow Globe........	50	28	1	87	80 to 96

Tabulating again such of these varieties as we have used for vegetation trials, we find:

	Variation on germination. Per cent. Table VI.	Variation on vegetation. Per cent. Table V.
Danvers Yellow...........	70 to 98	62 to 68
White Portugal...........	52 to 62	62 to 90

or the variation can be claimed as no greater in germination than in vegetation or *vice versa*, and hence we are enabled to logically assume that in onions we must anticipate extreme variations between seeds from the same package as possibly occurring dependent upon the drawing of the samples.

We may further assume logically that our figures, as given in our Tables I and II, are not gathered from a sufficient number of seeds used to admit of other than most general conclusions.

INDEX.

A.

G.

H.

I.

K.

L.

M.

N.

O.

P.